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THE NEW YORK EXCHANGES.

The special committee appointed by Governor Hughes on the subject of speculation in securities and commodities has made its report in a document that, taken broadly, cannot fail to have a reassuring effect on the public mind. The doubts and questions raised when the committee was appointed were somewhat disquieting, but a careful persusal of this report, made with evident painstaking and conscientious study, shows that, as usual of late, most of the fears were exaggerated or unfounded. This is evident from the fact that the committee has so few "reforms" to recommend and that these are all of a minor nature so far as the New York Stock Exchange is concerned. It is there that public utility securities and leading industrials are dealt in, and as these are of increasing volume and value, it would have been seriously unfortunate if the market methods of reaching trustworthy quotations had been found fundamentally improper. It is true that the committee expresses its conviction that only a small part of the transactions are of an investment character, but it wisely refrains from suggesting any more governmental interference with individual liberty along those lines, holding that the exchange itself has ample power to apply such correctives as might be needed. Hence its recommendations are limited to changes in rules, changes that can be easily adopted. Even the *al fresco* "curb market" is clearly proved to have its uses.

In discussing the Metal Exchange the committee is quite plain-spoken, the methods of making quotations being flatly described as "deceptive." It says bluntly: "Prices are manipulated up and down by a quotation committee of three," and this is alleged in plain language to be done "mainly for the profit of a small clique." Such being the case, the committee is of the opinion that both the Metal and the Mercantile exchanges do harm, and that their charters should be repealed. This would probably be a sensible course to adopt. The point may be raised, however, whether a thing is "deceptive" that does not actually deceive anybody, and the Metal Exchange has hardly succeeded in doing that.

One or two incidental matters of importance are touched. For example, it is recommended that there should be legislation controlling the "tipster" evil, under which stocks are boomed or depressed or other fake securities are floated. Of course the effect would be rather to drive such advertising out of New York than to suppress it; but papers used by such investment touts could be kept out of the mails. It is a difficult subject, and we have often grown weary answering inquiries as to fake electrical schemes thus being foisted on the unwary. Difficult, also, is the question of the sale of exchange quotations and the use of tickers. The committee goes so far as to propose a change in the common carrier law, enabling telegraph companies to refuse the transmittal of quotations or the lease of tickers where there is reason to suspect the criminal intentions of the applicants for service. This is obviously

tinkering with the law, but it would at least put the telegraph companies in a position to show that they mean what they say in regard to this old dispute.

Relative Merits of Core and Shell Transformers.

Alternating-current transformers may be divided structurally into two classes, namely (1) core transformers, in which the iron forms the core and the coils overlie it; and (2) shell transformers, in which the coils are overlayed by the iron, which is in the form of a shell, or cover. A typical form of core transformer is made of a Gramme-ring iron core completely concealed by the coils of wire applied to its surface. A typical form of shell transformer is made of coils of insulated wire completely enclosed by a mass of laminated iron. When, however, we vary the construction from these typical ancestors, we may arrive at half-breeds, in which it is difficult to say whether a core or a shell transformer is produced; and in fact, there are essentially similar transformer structures made in this country by different makers, one of which calls it a shell transformer, while the other calls it a core transformer. An interesting paper by Messrs. Fleming and Faye-Hansen, recently read in England on transformers, arrives at the conclusion that there is hardly any essential difference between the cost, efficiency or relative behavior of core and shell transformers. This is a comfortable conclusion, and it certainly fits the fact that there may be no difference in appearance between these types.

The Design of Spark Coils.

We publish in the current issue another paper by Prof. F. W. Springer, dealing with the design of jump-spark coils, which furnishes a continuation of some of his earlier papers on the same subject and leads to some interesting and practical conclusions. As a result of many experiments on such coils made by the aid of the oscillograph, Prof. Springer was enabled to get a quite clear idea of the various varieties of spark obtainable under different conditions. For the practical purposes of ignition the discharges produced by such coils are of three kinds: First, a mere break; second, a discharge similar to that of the Leyden jar, and third, a spark approximating the characteristics of a momentary arc. Of these obviously the brush has small igniting value. As regards the other two, Prof. Springer's experiments indicate nothing that may be accepted as decisive, although it is his opinion that a discharge of the third type is probably the most efficient under the most ordinary circumstances, particularly when the mixture is not very rich. This is obtained best with a rather short spark-gap and without a condenser in the secondary. Discharges of this kind may last several thousandths of a second. With a condenser of fairly large capacity and a considerable spark-gap, a very brilliant, thick-looking spark is produced, noisy and apparently very powerful. Its heating effect, however, is relatively small, owing to the fact that it is extremely brief. The concentration of energy is large, but in spite of the apparently powerful spark, the discharge will not ignite paper, although it will blow holes in it. Without the condenser, the discharge is spread over a longer period and has, upon paper at least, a considerably greater power of ignition. It is easy to see, therefore, that one may overdo the condenser in a spark coil and obtain weaker ignition effects than if there were no condenser at all. On the other hand, if the condenser be too small the result may be a series of sparks dividing the total energy of the discharge among them.

There would seem to be opportunity for still further experimentation on the exact conditions best suited to obtaining proper ignition of the gaseous mixture in an engine. In particular, the effect of the heating produced by compression must be taken into account. A very small spark will set off an explosive gas mixture, but practically all the experiments which have been tried upon such ignition have been tried with cold gas, and extremely little seems to be known about the generation of the explosion in gas which is both compressed and hot. Speaking generally, compression would imply somewhat greater difficulty in sparking between the terminals of the spark plug, and hence the additional jumping power of the condenser spark may be useful in spite of its brief duration. To get a complete notion of the practical conditions, such discharges should be studied under conditions of temperature and pressure somewhat similar to those in the engine. It is valuable, however, to know that it is not the noisy and fat-appearing spark that is always likely to produce the most efficient ignition. The ordinary spark coil as generally used gives too thin and weak a spark in the effort to produce so rapid a succession of sparks as to make sure of the timing of the explosion correctly. If it were possible to use a single spark with the concentrated energy now applied to a series and properly timed, the chances are that there would be better results in ignition. Prof. Springer points out that the improvements in the last few years have been in the direction of securing a more rapid break, which is good; but he thinks that a very much swifter break than is customarily used, concentrating the discharge into a single flash, would greatly improve the efficiency of the spark-coil system. The very violent spark obtained with the condenser has one advantage over the more prolonged and apparently hotter spark produced without the condenser, in that it is capable of breaking through greater resistance at the terminals, which may at times be useful. Most trouble in sparking is associated with dirty terminals, especially the formation of a conducting film, due to the carbonization of the engine oil and gas. It would be interesting to know under just what conditions a discharge circuit would be least affected by the tendency to form such a film around the sparking terminals of the plug. We trust that Prof. Springer will continue his interesting experiments with the view of passing from his very judiciously determined general principles of design to the production of a sparking apparatus that shall be able to break through obstructions and work through all kinds of adverse conditions. The increasing use of magnetos for sparking purposes has considerably changed the situation with respect to ignition, so that battery endurance is of much less importance than formerly and more attention can be put upon the problem of providing a spark that will work reliably even when the terminals are in bad condition and the mixture not what it ought to be.

Boiler and Engine Load Factors in Small Plants.

In an article elsewhere in this issue on "Engine and Boiler-Room Routine in Small Plants," attention is directed to the general tendency in small plants to operate machinery underloaded and thus make inherently uneconomical plants still more uneconomical. The average small plant is severely enough handicapped by the apparatus which it must use without introducing another source of loss in operating engines and boilers much too large for the loads which are being carried. Some small plants have no units small enough to be well loaded during 20 hours of the 24, which furnishes a reason why a

company should go very slow about discarding small old units when enlarging a plant. Very often the old units, if properly overhauled and with pistons and valves made tight, will operate with far greater economy than the larger new units, and this is true both in steam and gas-engine plants. The case may be cited of a gas-engine plant in which the coal consumption is about four times greater than was expected, due very largely to the very much underloaded condition of the engine. In another plant the coal consumption for the same cause was about double that which it should have been with properly selected sizes of engines. In the boiler room the working of boilers much underloaded is in itself likely to be uneconomical, because the fireman is not obliged in self-defense to stop waste and get the most possible out of his fires, as he would be if his boiler were run at nearly full load.

OVERHEAD LINE CONSTRUCTION.

The report of the N. E. L. A. committee on overhead line construction, presented at the recent convention, is a very satisfactory example of the technical committee report, in that it is logical in arrangement and rich in positive specifications as to material and methods. This is an unusual virtue and one to be duly appreciated, in view of the chaotic and padded character of many N. E. L. A. reports. It not only describes approved methods of doing things with sufficient detail for all practical purposes, but also gives an admirable set of subjects for specifications for the purchase of various materials. In particular we would call attention to the specifications for wire, which seem admirably adapted to securing a good and uniform article. The matter of poles is also treated in considerable detail, particularly with reference to depth and method of setting, points which have frequently been left somewhat to chance. In particular, line constructors will appreciate the details regarding pole location and guys on curves which embody a reasonably sound rule for general practice in a case where previously too much has been left to chance and individual judgment, sometimes of irresponsible men. The subject of guying, in fact, is taken up in admirable detail and if the advice of this report is followed the average pole line will be considerably improved, particularly as to its capacity of standing up under severe storms. The pole line is the vital point of electrical distribution and the more thoroughly standardized the better.

In one matter of policy in regarding pole lines the committee appears perhaps over-cautious—namely, in its reference to pole lines on private property. However useful a pole line may be, it is not a beautiful object, and there are cases in which a suitable right of way is greatly to be preferred from the standpoint of the public, to the right of way along the street. It is on the whole better for high-tension transmission lines, and indeed is frequently the only way of carrying such lines to many points desirable to be reached by them. There is another instance in which a private right of way is often needed, and this is the case of suburban line distribution through residence districts. It is possible in some places to get a back alley or back yard right of way which enables most of the distribution to be done without disfiguring the street with pole lines. We know in some instances in which comparatively all suburban districts have been supplied by pole lines located on the division lines between lots. The ordinary householder, if the subject is brought to his attention, would prefer to have an electric-light pole in his back yard on the division line between his yard and that of his neighbor, rather than have it planted squarely in front of his house; and where rights can be secured for this kind of distribution, it seems greatly to tend toward those pleasant relations between the electric light companies and the customers, which are so valuable to the former. It is true, as the committee indicates, that poles so located are not available for supporting street lights, but street lights in suburban districts are not usually placed so closely that special carrying poles for them are a severe burden, while the transformers are far less unsightly when located on poles out of sight than when thrust fairly upon the street. The adoption of alley or division pole lines sometimes requires considerable variations to be made in the length of span, which is at times inconvenient, but the general result in improving the appearance in the district served is worth a struggle to obtain.

Properly bearing on this same general subject of overhead line construction and to be taken in connection with this committee report, is Mr. Ives' well-written paper giving specifications for extra high potential lines, such lines being for the purpose of this paper set at a standard of 33,000 volts. This is perhaps a fair average, although not reached in the practice of many electric lighting companies even at the present time. Mr. Ives' specifications for poles and their setting are very similar to those recommended by those of the general committee. It may strike the casual observer, however, that Mr. Ives' specifications do not call for poles quite so sturdy and quite so deeply set as those of the committee. For example, for a 35-ft. pole, which Mr. Ives regards as standard for his purpose, the material being chestnut in each case, he recommends a minimum circumference of 22 in. at the top and 36 in. 6 ft. from the butt, while the committee report calls for a pole of the same circumference at the top, but 40 in. at the butt. Mr. Ives suggests a minimum depth of setting of 5 ft. for his 35-ft. pole, where the committee suggests 5½ ft. The fact is, however, that a transmission line intended as Mr. Ives specifies, to carry one three-phase line, a private telephone line and a single 2300-volt distribution line, does not require as heavy poles as would have to be broadly recommended for a distribution circuit which might carry a larger number of circuits and much heavier wires. The strains on a pole line are merely those imposed by the wires which it carries. In the extreme condition which pole lines have to meet—that is, the combined effect of wind and sleet—the number of wires is a very important matter, and it frequently happens that electric light lines with comparatively few wires will stand successfully where comparatively strong telephone poles burdened by a multiplicity of lines will give way. For high-voltage transmission service, however, a 40-ft. pole is preferable to one of 35 ft. through enabling one to use somewhat greater sag in the wires and somewhat wider spacing of the poles, both desirable from the standpoint of reducing the wire tension and the number of insulators, respectively. Mr. Ives' table of sags is a very useful one and he has a proper appreciation of the subject; but 20 ft. as the minimum height of the wire above grade appears a trifle low for a high-voltage line, and 25 ft. would be a more conservative figure, readily obtained by using the higher poles to which reference has been made. On the whole, the two papers under consideration form very valuable contributions to the standardization of line construction, and may also be recommended as models for the preparation of committee reports.

St. Louis Electrical League.

On May 8 a preliminary meeting was held in St. Louis to discuss the organization of the electrical interests of that city, at which the character of bodies formed elsewhere for a similar purpose was considered, with the final conclusion that an organization of the nature of a league is better for the purpose than the establishment of a club. At a meeting held June 15 definite action was taken, and a body known as the League of Electrical Interests was formed. Among the purposes of the new body is to bring together in a fraternal and co-operative spirit all those interested in or identified with the electrical industry in the city of St. Louis; to make the scope of the organization such as to interest not only those engaged on the commercial side, but also those interested in the legal, patent, professional and financial sides; to establish a channel and means through and by which questions of public interest affecting the welfare of the city of St. Louis may receive the considerations of the united electrical industries of the city, and to provide such educational and social features as will maintain the organization in a healthful state for efficient service, and along the lines for which it was organized.

The meeting was presided over by Mr. W. A. Layman, of the Wagner Electric Manufacturing Company, and was opened by an address from Mr. C. A. Houts, one of the leading attorneys of the city, who was followed by Mr. Jewett, who dwelt on the benefit to be derived by the formation of such an organization as that proposed. A committee, as follows, was then appointed to complete the plans for the organization: Capt. Robert McCulloch, chairman; Messrs. S. A. Hobson, H. H. Humphrey and F. E. Newbury; Mr. W. Robbins, secretary. In accepting the election as secretary Mr. Robbins said that in discussing the object of the league with the heads of several large houses, he was informed that these would be willing to give from $100 to $500 each toward a fund if any particular campaign were necessary. In assuming the chair Capt. McCulloch, who is vice-president and general manager of the street-railway system of St. Louis, delivered a vigorous speech showing his active interest in the organization. Considerable publicity was given to the formation of the league by the newspaper press, and two civic associations have already entered into relations with it.

Enclosed Fuse Litigation.

Justice Brown, of the Circuit Court of the United States for the District of Massachusetts, rendered a decision on June 11 in a case involving alleged infringement of an enclosed fuse patent granted to Carl Thalacker Aug. 1, 1893. The point at issue was whether the Thalacker patent covers broadly the use of an auxiliary indicating fuse in connection with an enclosed fuse. The Thalacker invention consists, as described in the specification, in combining with a strip of fusible metal, completely enclosed in a non-conducting box or case, an auxiliary fusible strip so located and connected as to be seen at all times, and which will be destroyed when the main fuse, which is out of sight, is blown. The device which was alleged to infringe this patent is one in which the main fuse is entirely surrounded by loose powdered insulating material, and is provided with a shunt indicating circuit, by means of which the blowing of the main fuse is made known by a visible indicator at the surface. The court held that the defendant's auxiliary circuit is not like that of Thalacker, a simple metallic strip of low resistance, but contains a very fine wire of German silver of high resistance, which does not melt or fuse, but which, upon the blowing of the main fuse, acts as a shunt and serves to conduct current to a paste indicator of high resistance and of a special composition that ignites only when upon the blowing of the main fuse sufficient current is forced through the German silver wire. The court considered it quite clear that the structure of the defendant's auxiliary circuit is not suggested by the Thalacker patent, and that it does not embody the Thalacker idea of operating an auxiliary metallic fuse of such small size that it could be safely exposed and left uncovered. Auxiliary circuits for signaling purposes had previously been used in connection with unenclosed safety fuses, as in the device by Mordey, described in a London electrical journal dated Feb. 3, 1893. Thus in the prior art, an enclosed main fuse had been provided with an external indicator operated by the main fuse, and unenclosed main fuses had been provided with auxiliary circuits to which indicating means were attached. In conclusion, the court held that, limiting the claim of the Thalacker patent to a scope commensurate with his specification, and regarding the inventions claimed as unitary structures designed for practical use as safety fuses, it is of the opinion that though the patent is valid, the defendant had borrowed nothing from Thalacker, and that the defendant's safety fuses are distinct combinations, both in respect to fuse protection and to exterior indication of the main fuse, and are not infringements. The parties to the above suit were the General Electric Company, complainant, and Fred B. Smith, defendant, the device in suit being the Sachs fuse.

Second Lighting Contract for Boston.

Superintendent of Streets Emerson, of Boston, will shortly call for bids for the lighting of streets and parks by small lamps for a five-year period beginning Sept. 15. Proposals will be received up to June 28, at noon, and it will then be determined whether the lighting will be done by gas or by electricity. At present this work is done by some 14,000 small lamps lighted by gas or naphtha. Under the new conditions the naphtha illumination will be eliminated and the service performed by either gas or electricity. The present cost of this lighting is about $350,000 per year, but the Edison Electric Illuminating Company, of Boston, has offered to do the work with tungsten lamps for about $50,000 a year less than is now paid. This new contract will not in any way interfere with the lately executed contract for the lighting of the important streets and squares, which was fully described in these columns. The work now in hand covers the illumination of streets of small traffic, where smaller units at frequent intervals are installed in place of high-powered lamps.

A Patented Subway.

Discussion of the project of building street-railway subways in Chicago has directed attention to the fact that a United States patent was granted recently to Mr. George W. Jackson, constructing engineer of Chicago, for an "Underground Subway for Street Railways, Etc." Mr. Jackson is reported to have said that his patent covers the most practicable way of building a subway under the conditions in Chicago, but other engineers believe that the essential features of a subway are not patentable, and that the granting of this particular patent, referring to a particular combination with public-utility service galleries, will not interfere with the city's plans.

The patent in question is No. 922,768, and was issued May 25, 1909. The application for it was filed on July 6, 1908. The fourth claim, which seems to fairly indicate the scope of the patent, reads as follows: "A subway for traction purposes comprising a floor, sidewalls and a roof, and posts supporting the roof from the floor and arranged in rows to divide the subway into centrally located passages to receive car tracks, and two lateral passages having means for supporting therein public-utility appliances, and a horizontal or sub-roof between said car-track passages and the main roof, and said aisles being provided in line with said horizontal partition with horizontal supports, the whole dividing the upper part of the subway into a space through which is adapted to extend public-utility appliances of streets which intersect the subway, and into which are adapted to be carried or deflected certain of the public utilities carried in the lateral passages or aisles."

Annual Meeting of New York Electrical Society.

The New York Electrical Society brought its successful 1909 season to a close on the evening of June 15 at a meeting in the "Sun Parlor" of the Waldorf-Astoria. The secretary's report showed that during the year the society has elected 92 members. There have been seven deaths and 25 resignations, and 102 names have been dropped for non-payment of dues. The year closed with a net membership of 835. The election of officers for the season 1909-10 resulted as follows: President, Mr. Theodore Beran; vice-presidents, Messrs. John Bottomley, Frederick A. Scheffler and Charles H. Hadlock; secretary, Mr. George H. Guy; treasurer, Mr. Henry A. Sinclair. After the election Mr. Cloyd Marshall gave an informal address on "The Commercial Development of Wireless Telegraphy," an abstract of which was printed last week, and the station of the United Wireless Telegraph Company on the roof of the hotel was thrown open for inspection.

Telephone Contract Agents in Convention.

The annual meeting of the commercial representatives of the Bell telephone companies of the country was held at the Auditorium Hotel, Chicago, on June 15 to 18, inclusive. About 90 delegates were present. Mr. George C. Brooks, of Indianapolis, chairman of the executive committee of the association, presided, and Mr. A. M. Ramsay, contract agent for the Chicago Telephone Company, was the host on behalf of the Chicago company. The delegates discussed subjects of importance in their branch of the telephone business during a busy four-day convention. Particular attention was paid to consideration of ways and means for the further expansion of business and of methods for increasing toll traffic. Papers on correct advertising and publicity campaigns and the extension of lines into rural communities were also read. The visitors inspected the Main exchange of the Chicago Telephone Company and the Hawthorn works of the Western Electric Company. The "wind-up" was a complimentary banquet in the "gold room" of the Congress Hotel on Friday night. Mr. Bates, of New York, was toastmaster, and speeches were made by Mr. B. E. Sunny, of Chicago, vice-president of the American Telephone & Telegraph Company and president of the Chicago Telephone Company; Mr. A. S. Hibbard, vice-president of the Chicago Telephone Company, and others.

Space Between Passing Street Railway Cars.

Mr. Bion J. Arnold, chairman and chief engineer of the Board of Supervising Engineers, Chicago, which has in charge the street railway rehabilitation in that city, advocates a greater distance between track centers than is the case in the new street-railway work in that city. In a letter to the City Council committee on local transportation, he says that he would issue no further permits for track construction, if he were a commissioner of public works, unless the distance between track centers was 10 ft. 2 in. As the present standard distance between track centers is 9 ft. 8½ in., with clearance of 8½ in., this would increase the distance between passing cars to 14 in. In addition, the cars might be narrowed to an over-all width of 8 ft. 6 in., and this would leave a space of 20 in. between passing cars without lessening the space between the sides of the cars and the curbstone. With a space of 20 in. between passing cars, a person caught between cars in the middle of the street would have sufficient room to stand without being crushed, and for that reason Mr. Arnold urges that all tracks laid henceforth shall be spaced 10 ft. 2 in. between centers and that no cars shall be hereafter built which are more than 8 ft. 6 in. in over-all width. "As time went on," says Mr. Arnold. "cars of the present width could be eliminated, and ultimately we would have a reasonably safe traction system, so far as the danger of persons being crushed is concerned."

Under the present standard several fatalities have occurred by persons being caught between cars and crushed to death; and it is to prevent accidents of this character that the change in the plans is advocated. Mr. Arnold says that his original position was in favor of the wider space, but that he was overruled by the other members of the board.

Convention of Iron and Steel Electrical Engineers.

The second annual convention of the Association of Iron and Steel Engineers is being held in Buffalo the present week. The principal sessions will be held on Wednesday, when the business of the association will be considered, and papers will be presented and discussed by members. Thursday and part of Friday will be devoted to a program of papers to be presented by representatives of electrical manufacturing companies. The Westinghouse Electric & Manufacturing Company is represented on this part of the program by Messrs. C. F. Scott, B. Wiley and Edwin Gawger; the General Electric Company by Messrs. D. B. Rushmore, Pauly and Whiting; Electric Controller & Manufacturing Company by Mr. C. Pirtle; C. J. Toerring Company by Mr. C. J. Toerring; American Fuse Company by Mr. Lynde Bradley. Place on the program is also reserved for representatives of the Crocker-Wheeler Company, Westinghouse Machine Company, Adams-Bagnall Company and Wagner Electric Company. On Friday and Saturday visits will be made to various steel works and to other plants in Buffalo and vicinity, and in Niagara Falls.

Electricity in the Production of "Joan of Arc."

Electricity played a most important part in the successful presentation of Schiller's "Joan of Arc" by Miss Maude Adams at the Harvard Stadium on June 23, under the direction of Mr. Charles Frohman, for the benefit of the Germanic Museum of Harvard University. The performance was scheduled to be given in the open air and after dark, and the problems of producing the requisite grades of illumination over the extensive area upon which the action took place were of extreme difficulty. Aside from the auxiliary equipment necessary to produce the effects of lightning, thunder and rain, sunrise, and other natural phenomena, it was necessary to hold the organization of about 2000 performers in strictest control. The work was done electrically, with many special and unique devices used here for the first time on a large scale.

About 60 per cent of the seating capacity of the Stadium was utilized, accommodating an audience of over 18,000 persons. Power was derived from the Allston electric plant of the Boston Consolidated Gas Company, four two-phase 2300-volt circuits being run to the grounds on a special overhead line erected for this performance. One unit in the power house, which is located about a mile from the Stradium on the south bank of the Charles River, was reserved for the "Joan of Arc" service. The full load demand of the performance was about 350 kw. The supply of energy from the power plant was brought by the lines into a power enclosure underneath the Stadium seats, where were mounted main switchboards, step-down transformers, and a motor-generator set for direct-current service supply. The motor-generator installation consisted of a 125-hp, two-phase Westinghouse induction motor, 785 r.p.m., belted to a 100-kw, 125-volt general electric generator making 500 r.p.m. The motor was started by a compensator and had to be run at 50 per cent overload during the peak load of the play. A frame switchboard was erected near the generator with six knife switches controlling 75 stage arc lamps, a 30-in., 24-in., four 9-in. and two 12-in. searchlights, with 15 stage effects by sky-opticon lamps. A second switchboard was also erected for controlling the alternating-current distribution from the secondary sides of the transformers. This service

supplied small induction motors and both arc and incandescent lighting installations. Twelve transformers were installed, ranging in capacity from 15 to 45 kw. The motor and the generator were erected upon concrete foundations.

The Harvard Stadium is of horseshoe shape, and the control of the performance was from the stage manager's box, located in the center of the horseshoe. Four cue stations were established at different points on the edge of the arena, with a white, red, green and yellow incandescent lamp located at each. Different combinations of these lamps were utilized to indicate the various commands of the manager in connection with the movements of the personnel. A telephone service was also instituted between the stage manager's quarters and the cue stations, for use in case of emergency. The colored lights at each cue station were controlled by knife switches at the manager's box, there being two lamps of the same color in series in each 250-volt circuit, one being at the manager's box and the other at the cue stations. The manipulation of the lamps was a quicker process than telephoning. A similar system of signaling was used by the chief electrician in controlling the various moves of men in his department behind the scenes. The electrical controlling stand was located on the east side of the Stadium, while at different points on the structure were massed four batteries of 12 6-in. electric spotlights, controlled individually and also from the direct-current switchboard frame in the power room. Six flaming arcs hung above the different sections of the structure were used to enable the audience to find their seats, and a separate circuit of four emergency arcs wired to the operating board and thence connected by special line with the power station was provided to prevent the audience being in darkness in case the supply of power from the regular service failed. Twenty alternating-current enclosed arcs were installed underneath the Stadium in the passageways to facilitate ingress and egress. The searchlights were mounted on the upper part of the Stadium, with the carbon somewhat out of focus and near the reflectors, with frosted gelatine screens to secure the proper diffusion of light. Lightning flashes were produced by the striking of 125-volt arcs by electromagnets, carbons and files set in hoods on two high points of the scenery, and the effect of forked lightning on a distant sky was obtained by quickly capping and uncapping the lens of an electric projector lamp with a slide traced with zigzag lines. Cloud effects and the appearance of a rising moon driven by clockwork also depended upon the electric projector lamp for success. About 300 colored incandescent lamps of 32 cp each were installed on a frame behind the scenes and connected with dimmers, to simulate a sunrise effect. A 50-amp moving-picture machine was used to produce the effects of the famous spirit advisers of the play, upon a tree 50 ft. distant from the lamp. To save overloading the generator, the upper batteries of direct-current spotlights were connected with the resistances of each pair in multiple and the carbons in series.

The production of "thunder" was effected by a car with corrugated wheels running over a strip of boards over a hollow trough 170 ft. long, a 3-hp Wagner 220-volt induction motor being connected with the car by pulleys. There was also a thunder drum composed of a hollow cylinder with small baseballs attached to the surface by ropes, the device being revolved by a 2-hp, 220-volt General Electric induction motor, with the balls striking against canvas. A 1-hp Roth motor wound for 125 volts direct-current was direct-connected to a fan blower which forced air through two sets of "devilines" in funnels, to represent the whistling of the wind. The speed and intensity of the sound was regulated by a starting box. A rain drum 3 ft. in diameter and partially filled with birdshot was provided, the ordinary drive being by a 1-hp, direct-connected motor. About 70,000 ft. of wire were used, ranging from No. 4 stage cable and No. 1 copper to No. 16 wire, for cue board signaling. About five weeks were required to develop and install the electrical equipment, which was specially designed and applied to the production by Mr. Jack Mayer, who was ably assisted by Mr. Al Jenkins, with Charles Frohman, New York.

Convention of the Canadian Electrical Association.

The nineteenth annual convention of the Canadian Electrical Association was held at Quebec on Wednesday, Thursday and Friday (June 16-18) of last week, with headquarters in Chateau Frontenac. A local committee, of which Mr. E. A. Evans was chairman, furnished an admirable program of entertainment, which included a special performance at Rustic Theater, Montmorency Falls; a visit to the Royal Mail steamship *Empress of India* to witness a fire and collision drill, and a trip in a Government vessel to points of interest in the harbor. Below are given abstracts of some of the papers presented, which will be supplemented next week by other abstracts, together with details of the meeting.

An interesting paper was presented by Prof. L. A. Herdt of McGill University, and Mr. N. J. Dalemont, of *La Lumière Electrique*, Paris, entitled "Electrolytic Lightning Arresters." After referring briefly to some of the well known types of lightning arresters, the liquid electrode arrester and the aluminum cell arrester are described in detail. The former consists of two metallic electrodes either dipping in an electrolyte of high conductivity placed in an earthenware vessel or arranged with a small air gap between the electrolyte and the electrodes. As current passes, in either case it throws the electrolyte away from the electrodes, thereby increasing the resistance in the path of the discharge, breaking the arc and also the dynamic current, and finally automatically resuming contact with the electrodes upon return of normal conditions. Experiments have shown that this action is so rapid that little deformation of the e.m.f. wave of the line takes place, even when the discharge occurs when the e.m.f. is at or near its highest value. This arrester has a well-defined critical voltage, below which arcs are suppressed, and above which passage of the dynamic current is interrupted. The aluminum-cell arrester described consists of aluminum disks stamped in the form of annular cups and covered with a thin film of oxide, which are placed one on top of the other to form a column, and separated by insulating disks or washers. The cups are filled with an electrolyte, consisting of an acid solution, either citrate of magnesium or citrate of aluminum; the whole combination is placed in earthenware jars, a certain amount of insulating oil being placed on top of the electrolyte to prevent evaporation. A number of such arresters can be placed in series in case of high line voltages. The critical voltage per disk varies from 380 to 400, depending on the voltage used when the disks are formed. At a high potential, due to static discharge, the film of oxide of the aluminum is punctured, but when the voltage becomes normal the film is reformed automatically, and the arrester is again ready to operate. Aluminum cells are built for 4,000 volts up. When the line voltage is higher than about 13,000 volts, multigap arresters are used placed in series, and for still higher voltages horn-gap lightning arresters are used.

Some experiments with aluminum cell batteries are detailed as follows: In a bath containing 6 per cent of bicarbonate of ammonia two plates of aluminum were used as anodes, and a plate of nickel as cathode. The two aluminum plates were electrically connected together and current was obtained from a storage battery. The film of oxide formed on the plates was at first thin, but thicker formations were obtained by increasing slowly and gradually the voltage and again later by lowering it to smaller values than at first used. The ohmic resistance of the film of oxide found as high as 21×10^8 ohms per sq. cm. It is not constant and diminishes when the applied voltage is increased. The resistance, however, depends on the voltage used when the plates were formed, so that at a given voltage the higher the voltage of formation, the larger will the resistance be. In experiments made with such plates used as condensers, the film of oxide weakened after operating continuously for some time, and finally gave out. It was found necessary in such cases to provide a formation circuit

in the shape of direct current to form the oxide film again. It would, therefore, seem advisable, in view of the above facts, to use horn-gap or other type of air-gap protection in series with this type of arrester, as when placed directly between wire and ground a condenser action must necessarily take place. The paper closed with the statement that aluminum cell batteries should provide excellent safety valves against line disturbances.

In a paper entitled, "Accounting for Electrical Companies," Mr. R. F. Pack, accountant of the Toronto Electric Light Company, presented the details of a system of accounting for central stations. In opening he said that while at present Canadian central stations are not compelled to make drastic changes in their accounting systems by any process of law, the advantages to be gained by a proper system of accounting are beginning to be realized more and more, particularly as the time may arrive when the provincial legislatures will require reports similar to those prescribed by the State governments in the United States and by the Board of Trade in Great Britain. The paper gives in complete detail a classification of main central station accounts suitable for smaller central stations, together with a classification of sub-accounts to suit the requirements of these and of larger central stations. This classification, which is largely based upon the N. E. L. A. classification and those of the New York and Wisconsin Public Service Commissions, does not admit of abstract.

Mr. L. W. Pratt, of the Hamilton Electric Light & Power Co., presented a paper entitled, "Power Rates for Central Stations," which gives schedules of motor rates based upon those in use by several central stations. One of these is a schedule of flat rates, and the others are based partly upon meter rates, and partly upon minimum charges, discounts, etc.

Mr. B. T. McCormick, of the Allis-Chalmers-Bullock Company, in the paper "Synchronous Motors Used for Power-Factor Correctors," sketches the principles of the use of synchronous motors for power factor correction, and gives several curves and diagrams whereby the capacity may be determined of a synchronous motor for the regulation of a given circuit. A motor with a weak armature, or in other words one with relatively few turns on the armature, is best adapted to the improvement of power factor, as such a motor will draw a large leading current from the line and give an increase in speed strength. This characteristic of a weak armature is one of the elements which goes to make an alternator of good regulation, but it is stated to be a poor criterion when issuing specifications for synchronous motors to specify a certain regulation for a motor when used as a generator, as a generator may be designed with a strong armature and a large air gap, and thus be unfit for use for the correction of power factor, owing to the poor corrective power of the strong armature, and to the tendency toward field heating.

A paper by Mr. S. E. Doane, chief engineer of the National Lamp Association, entitled "The Conservation of Our Natural Resources Through the Use of High-Efficiency Lamps," after giving statistics as to the coal consumption of the United States and other countries, estimates that by a liberal replacement of carbon by metallic-filament lamps, the rate at which fuel is being consumed for incandescent lighting could be reduced by at least one-half, thus enabling $8,000,000 worth of coal to be saved in the United States alone. In order to introduce metallic filament lamps without loss, however, it is necessary to change the present methods of charging for current by the kilowatt-hour, which is declared illogical. A proper system of rates should be based upon all of the factors entering into the actual cost of serving the consumer. The Doherty readiness-to-serve rate rests oh this sound principle, and covers the three items of expense entering into service by three corresponding charges to the consumer. An illustration of this system is a total charge consisting of 15 cents per month for every 16-cp lamp or equivalent connected, as a capacity charge; 75 cents per month regardless of current consumed or lamps connected, as a consumer's charge; and 5 cents per kw-hour as an output charge. A discount of 10 per cent is usually allowed on a bill if payment is made before the specified time. It is stated that the multiple rate system seeks to reach the same end, and that almost every rate system which makes any pretense at covering fixed charges is a modification of the readiness-to-serve system. Mr. Cole, in his paper, described the several standard forms of shell type and core type transformers, and pointed out the advantages and disadvantages of each of these types. The conclusion of the discussion is that, as far as weight and efficiency are concerned, there is very little choice between the two types. Close regulation is much easier obtained in the shell type, and to obtain an equivalent close regulation with the core type involves a construction that may sacrifice such features as good insulation and mechanical strength. He also stated that while the main advantage of the core type lies in the fact that the top yoke may be made removable, and the individual coils easily taken out for repairs, it has been the experience of some engineers with these "simple" repairs that the more simple method of returning the transformer to the manufacturer to be fixed up is easier and better in the end. Since three-phase systems are usually laid out with a view to motor loads, the question of regulation on inductive lines is an important one where three-phase transformers are considered and the shell type would in a large majority of these cases be preferred. Mr. Cole, in ending his paper, said that the time is not yet ripe to relegate the shell type in the background, in view of the satisfactory work that this type is still doing every day on high-tension systems.

Some Chicago Central-Station Statistics.

Addressing the ways and means committee of the Chicago Association of Commerce recently, Mr. John F. Gilchrist, assistant to the president of the Commonwealth Edison Company, Chicago, gave a brief illustrated survey of the central-station service of Chicago. The Chicago Edison Company, the predecessor of the existing company, began business in August, 1888, with a station capacity of 800 hp and a connected load of approximately 20,000 16-cp equivalents, serving about 250 customers in the down-town district. In those days the lighting rate was 1 cent per 16-cp lamp hour, with a sliding discount of from 5 to 20 per cent on monthly bills of over $50. At the end of 1908, a little over 20 years from the beginning, the connected load had grown to the impressive figure of 4,500,000 16-cp equivalents. The total generating and battery capacity is now about 300,000 hp, and the number of customers is about 86,000.

During the last five years the company has expended for investment, operation, repairs and renewals a total of $41,600,000, exclusive of bond interest, dividends and depreciation. The daily consumption of coal is about 2000 tons. The rates have been steadily reduced; for instance, in 1905 the monthly bill of an average residence customer using 30 kw-hours per month was $4.50. Under the same conditions his bill to-day would be $2.70, a reduction of 40 per cent. Another fact of much interest cited by Mr. Gilchrist is that the Commonwealth Edison Company is actually selling power in Chicago produced by steam generating plants at a cheaper rate than the Niagara Falls power companies sell their hydro-electric power in the city of Buffalo.

The company employs on an average 2500 men, exclusive of the large construction force employed by contractors on new work. There are over 5000 electric signs in the city. The company has done more, said the speaker, to purify the atmosphere of Chicago by putting out of business and preventing the erection of over 4000 smoke-producing chimneys than all the smoke-nuisance fines imposed by the municipal courts. "It is a part of our business," said Mr. Gilchrist, in conclusion, "to convince the man who generates his own power by means of a small steam plant, or who contemplates doing so, that we can sell energy to him cheaper than he can manufacture it. We have been so successful along this line that there are now less than 1500 isolated plants in the city of Chicago, whereas we have 10,000 power customers on our system."

High-Voltage Metallic Filament Lamps.

The English electrical journals report the appearance on the British market of several new metallic-filament lamps of 100-130 volts and 16 hefners, and 230-260 volts and 32 hefners. The former take 17 watts and give 14.4 British candles, a consumption of 1.18 watts per candle. The latter take 40 watts and give 28.8 candles, a consumption of 1.39 watts per candle.

Recent tests at the National Physical Laboratory on older types of 222-volt, 50-cp metallic-filament lamps showed an average consumption of 1.4 watts per candle. Of nine lamps tested five were burning at the end of 2000 hours, the life of the others having been 600, 800, 1350 and 1760 hours, respectively. The candle-power of the lamps increased up to 400 hours, and then gradually declined until at 2000 hours it was 87 per cent of the initial value. During the first 950 hours the consumption fell as low as 1.33 watts per candle, and at the end of 2000 hours was 1.6 watts per candle, the average being 1.4 watts.

Telegraph Companies Oppose Massachusetts Telegram-Filing Act.

The committee on mercantile affairs of the Massachusetts Legislature gave a special hearing on June 18 on an amendment to the recently passed telegram-filing act. This act, as previously noted in these columns, provided that the times of filing and receiving should be placed upon all telegraph messages sent within the State to points within the State, and it became a law without the signature of the Governor. Immediately after the law went into effect the companies instituted a charge for the words added, and the average number of words required to transmit the filing time was four or five. The proposed amendment to the law was that no charge should be imposed upon the customer of the company for the filing of the times.

For the Western Union Telegraph Company, Counsel Arthur Lord stated that the law necessitated the transmission of more than 50 per cent additional words, which would be without compensation if the amendment passed. Problems of this character, he believed, should be brought before the tribunal which has been created by the Legislature for adjudicating precisely these questions, namely, the Massachusetts Highway Commission. There are over 230 telegraph offices in Massachusetts where the gross monthly revenue does not exceed $10; 65 offices where it runs from $3 to $5 per month, and 98 offices where it is not over $2 per month. The business is by no means the sinecure that many persons suppose. By the law the Legislature either imposes an intolerable hardship upon the company or else places an unnecessary burden on the consumer. In other places where the filing time has been included the extra words have been paid for. There is no practical code system for different times of day known to operators in Massachusetts. The law imposes a penalty of $100 for an error in or the omission of a single letter or figure, and the only safe course for the company is, therefore, to transmit the filing time in full. Many operators in Massachusetts are employed by the railroads, and it is hard to run chances of the errors of other than regular employees of the telegraph company. The Western Union, said Mr. Lord, ought not to be held responsible for mistakes committed in railroad telegraph offices. The company does its best, but the traffc fixes the limitations of possible service. Such legislation is unnecessary and ought to be considered instead by the Highway Commission. So far as he knew, no customer has ever made the request that the filing time be put upon the message, and nothing has been introduced to show that anyone would suffer hardship or be injured if the filing time should not be included. Unless an additional burden like this is paid for, it may be confiscatory in its nature. If such a law should be passed all over the United States it would cost the companies millions of dollars a year. About 60 per cent of the Western Union messages are stock-exchange telegrams, or else messages closely associated with financial dealings; 20 per cent of the dispatches are for newspapers; 15 per cent are railroad messages, and 5 per cent are for all other kinds of business and social purposes. Less than 3 per cent of the telegrams are private or social in nature.

Counsel Wardner, for the Postal Telegraph-Cable Company, stated that his organization is willing to send the filing time free of charge for any customer who asks for it in writing. The Legislature has an undoubted right to take up these questions, but they are complex, and its actions, like those of all other law-making bodies, are subject to the test of constitutionality. The companies are clearly entitled to a reasonable return upon their investments.

Electrical Engineering at the Massachusetts Institute of Technology.

As indicating the trend of electrical engineering study at the present time, it is notable that 40 per cent of the students just graduated from the electrical engineering course at the Massachusetts Institute of Technology already bore degrees of bachelor of arts or bachelor of science, conferred, as a rule, in classical or literary courses. The colleges conferring these degrees are spread over the land from Nova Scotia to the State of Texas and the State of Washington, and include some of the most important universities of the East and the West, besides a number of the lesser colleges. These men are going into a wide variety of activities, from the manufacture of electrical instruments and of incandescent lamps to electric transmission of power and heavy electric traction.

Mr. H. S. Osborne and Mr. W. S. Rodman, who are candidates for the degree of doctor of engineering in the electrical engineering department, have recently been appointed fellows by the faculty of the institute. Mr. R. L. Jones has been appointed graduate scholar in electrical engineering.

The course of electrical engineering research and the advanced instruction of gradute students in electrical engineering has been advanced by the appointment of Dr. Harold Pender—who is the subject of a personal notice in another column—to the chair of theoretical and applied electricity. Dr. Pender's teaching at the institute will consist of a course for third-year undergraduate students and courses for graduate students in the more advanced theories of electric current flow and the electric transmission of power, in addition to the direction of experimental research by advanced students.

The advanced lectures on the organization and administration of public-service companies, on the design of power stations and systems, and on electrical measurements heretofore carried on by Professor Jackson, Professor Shaad and Professor Laws will be continued by the same professors. This organization makes a remarkably favorable one for graduate students of adequate preparation who propose to spend one, two or three years in advanced study of the greater problems of electrical engineering.

The Telephone in Emergency Construction Work.

The use of the telephone in emergencies justifies the cost many times over. It is difficult to place a money value upon such service, for it makes possible activities which would otherwise extend over protracted periods, if, indeed, they could be accomplished at all. One of the latest examples of the supreme importance of the telephone in a time of crisis is afforded by the recent fire at the Norumbega Park Theater, at Auburndale-on-the-Charles, Massachusetts. The fire broke out at 2 o'clock in the morning, and General Manager Brush of the Boston Suburban Electric properties was on the scene within 20 minutes. A hasty inspection of the situation showed that nothing could be done to save the theater, and it was at once decided to rebuild it, in order to save a revenue of upward of a thousand dollars a day for the remainder of the season. Headquarters were immediately established at a special

telephone set located on the scene of the fire, and insurance adjuster, architect, engineers, contractors, structural steel men, and over a hundred men from the railway company's own organization summoned to the spot. Two hours after the fire started the designing engineer was on the ground planning for the erection of a new structure, and in another hour carpenters and contractors were present to figure upon the cost of rebuilding. At 5 in the morning the ruins were cool enough to permit beginning the work of removing the debris, and at 10 o'clock the first lumber arrived for the new structure. New plans were drawn, with specifications, and the contract was awarded for the new theater within 48 hours of the time when the fire occurred. Construction started on the next day, and in just seven days the theater, seating 3000 persons, was completed.

The telephone was literally indispensable in this work, since the park, which is in a beautiful residential district, is located 10 miles west of Boston. The control of the entire situation was maintained by this means, and the ordering of materials and labor accomplished in the shortest possible time. During the entire period from his arrival on the ground to the completion of the theater, the general manager was practically always at the end of this telephone line. Without the telephone the work could not have been done; the company would have suffered an extraordinary loss of revenue, and only after weeks, if not months of slow and trying delay, would it have been possible to open the new structure to the use of the public. Electrical connection with the outside world enabled orders to be placed and deliveries hastened without the usual tedious course of waiting for the mails to go their appointed round, and permitted the chief executive of the organization to keep in touch with the regular work of the system so far as necessary, while the emergency construction was going forward. Such a situation could not possibly have been handled by correspondence, and even the automobile would not have annihilated distance quickly enough to permit the creation of a theater of this size within a single week. Even the advertisements of the work, drawing large crowds of people to the spot, were placed by telephone, and the results showed the wisdom of the choice. Although the regular telephone station of the park was located within 800 ft. of the fire, another station was established directly at the theater to save time. Thus, the telephone was perhaps the most important auxiliary, next to the food provided the workmen, that made it possible for such a triumph of executive ability to be realized.

New York Public Service Commission News.

A definite proposition has been made to the Public Service Commission by the Bradley-Gafney-Steers Company to build an elaborate system of subways in New York. This work is to be done under the new law which provides for the construction of subways by private capital. The company proposes to build the Broadway-Lexington Avenue route, as mapped out by the commission, running from the Battery to the Harlem River, thence dividing and running in two branches to Van Cortland and Pelham Bay parks, also to operate the bridge loop which the city has almost completed, to build the Broadway-Lafayette Avenue route in Brooklyn and the Fourth Avenue, Brooklyn, route as far as Fortieth Street in Bay Ridge. Altogether, this is the most comprehensive subway plan that has yet been formulated, and entails the expenditure of about $101,000,000. Of this amount the city will be called on to spend only about $26,000,000, which would be for the completion of the work already begun. The company is ready to take the work under the indeterminate franchise arrangement proposed by the commission. It is generally understood that the commission will approve the application and that the franchise will be passed on to the Board of Estimate and Apportionment before it adjourns for the summer. The company bidding for this work promises to have the construction completed within three years.

The Public Service Commission, after a rehearing, has refused to approve the franchise asked by the South Shore Traction Company for a line over the Queensboro Bridge. This franchise has already been allowed by the Board of Estimate, and the company now proposes to carry the matter to the courts to test the legality of the commission's refusal.

The Public Service Commission has approved the franchise of the New York & North Shore Traction Company for an extension of its line from the New York city line at Little Neck through Flushing to Chestnut Street in Whitestone. This permit has already been granted by the Board of Estimate.

Some Recent Costs of Electric Power Production.

In the following paragraphs are given some notes recently taken of the cost of generating electricity, excluding fixed charges, in three plants located in New York State, as deduced from the returns filed with the Public Service Commission of the Second District. At present it is difficult to analyze the cost of production in many of the plants of this State from the returns filed, for the reason that many of the companies are fortunate enough to use hydro-electric power in addition to the steam-plant service which they furnish. The number of stations of even moderate capacity which operate steam plants exclusively is greatly limited. The absence of figures extending over several years of operation also precludes technical comparisons of the conditions and results obtained by individual companies throughout a considerable period. Nevertheless, data from single plants covering short periods are suggestive as to the cost of manufacturing electricity under definite conditions of equipment and fuel supply.

The first plant considered is the Utica station of the Hudson River Electric Power Company. This plant has a rated capacity of 6000 kw. It has eight Heine boilers of 488 hp each, and four Cahall boilers of 509 hp each, operated at 175-lb. pressure, the total boiler rating being 5940 hp. The electric generating equipment consists of two 1000-kw and two 2000-kw Curtis-General Electric turbo-alternators wound for 2300 volts and transmitting power to substations at Amsterdam, Oriskany, Frankfort and Little Falls through step-up transformers located in the station at Utica. A large percentage of the output of the Utica station is devoted to electric railway service. In the calendar year 1908 the station at Utica generated 19,751,300 kw-hours and sold a total of 15,750,930 kw-hours. Of this, 15,502,095 kw-hours were delivered for electric railway service, including the operation of the electrified section of the West Shore Railroad between Utica and Syracuse.

The operation of the Utica plant required the services of 7 engineers, 2 pumpmen, 5 switchboard men, 25 boiler-room men, 3 mechanics and carpenters, 25 coal-passers and miscellaneous employees, with one clerk and superintendence by three officials having general oversight of the company's electric power-plant equipment. Only a small part of the time of the superintendents was assignable to the Utica station. The following table gives the cost of manufacture per kw-hour delivered at the station bus, the average cost per ton of fuel being $2.14. During the year the company burned at Utica 29,045 tons of anthracite and 5361 tons of bituminous coal.

COST OF PRODUCTION AT UTICA PLANT, 1908.

Station superintendence	$483.14
Other steam labor, .227 ct. per kw-hour, or	44,286.91
Fuel, .374 ct. per kw-hour, or	73,649.82
Oil, waste and sundries	797.65
Water	361.65
Repairs, building	464.05
Repairs, motive power	1,315.98
Repairs, electrical equipment	4,677.99
Station expenses	4,563.03
Purchased power, 28,489 kw-hours	237.74
Total, .66 ct. per kw-hour, or	$130,837.96

The average output of this station per day was 54,097 kw-hours, the maximum load on the plant during the year being 6000 kw; defining the load factor as the quotient of the average kw-hours per day divided by the maximum possible output at normal station capacity for the same period the result is 37.5

per cent for the year. The company reports the cost of the station building to be $337,273.43; the cost of the steam equipment, $268,126.74, and the cost of the electrical equipment, $187,440.10. The excellent cost of production at the station is clearly made possible by the good load factor of the plant and the low cost of fuel per ton.

The second plant is that of the Jamestown Lighting & Power Company, at Jamestown, N. Y. The rating of the station at normal output is 908 kw, and the figures cover the year 1908.

The steam-generating equipment consists of one 150-hp, one 125-hp and two 150-hp boilers of the horizontal return-tubular type, the average steam pressure being about 125 lb. The total boiler rating is 575 hp. There are five engines and 12 generators in the station. The engine equipment consists of one 12-in. x 21-in. Buckeye compound condensing outfit, rated at 250 hp; one Armington & Sims 100-hp engine; one 15¼-in. x 26½-in. 300-hp Buckeye, and two 11-in. x 20-in. Dick & Church 175-hp engines. The total generator capacity is 908 kw. During the year the plant generated 878,140 kw-hours, or an average of 2406 kw-hours per day. The maximum load was 487 kw. The labor requirements of the plant were four engineers, one oiler, two firemen and one machinist. Bituminous coal was burned, costing the company an average of $2.74 per ton, the total quantity consumed being 3750 tons during the year. The coal consumption per kw-hour was 8.54 lb. The operating cost of the station for the year was as follows:

COST OF PRODUCTION AT JAMESTOWN PLANT, 1908.

Station labor, .515 ct. per kw-hour, or	$4,533.20
Fuel, 1.16 cts. per kw-hour, or	10,283.42
Oil, waste and sundries	838.78
Water	46.45
Repairs, building	187.35
Repairs, motive power	1,487.93
Repairs, electrical apparatus	264.45
Total, 2 cts. per kw-hour, or	$17,641.58

Defining the station load factor as in the case of the Utica plant, the Jamestown station had a ratio of 11 per cent between the average daily output and the total energy which might have been generated in 24 hours had it been possible to operate the plant at full load for that period. The conditions afford considerable contrast between those prevailing at Utica. In the Jamestown case the company is handicapped by a somewhat higher cost of coal, but the two chief points against a high station efficiency are the smallness of the demand upon the plant for service in relation to its capacity and the operation of apparatus which to a considerable extent represents a type which would not be installed if a new station were built. It appears that the power load of the company is small, and this, with the use of belted apparatus to some degree, makes it difficult to generate current at specially low figures. The relative importance of the fuel consumption and cost per unit of output is indicated. With an increased load upon the plant, it is probable that a noteworthy improvement in economy would result, even with no change in the equipment.

The third station considered is that of the Binghamton Light, Heat & Power Company. This station has a normal capacity of 2000 kw, and in the fire-room are three Stirling water-tube boilers rated at 375 hp each and built for operation at 200-lb. steam pressure. The record covers the last half of 1907. In the engine-room are one 700-hp Corliss engine, direct-connected type; one 500-kw Curtis turbine; one 500-hp Erie-Ball belted engine, and one 500-kw Allis-Chalmers turbine. The electric generating units consist of two 500-kw General Electric three-phase alternators, two General Electric belted alternators rated at 200 kw each, a 500-kw Allis-Chalmers alternator, and a 150-kw Westinghouse motor-driven, 500-volt generator. The station was operated by a force of four engineers, two switchboard men and five boiler-room attendants. The company burned 3752 tons of coal during the half year, costing on the average $2.44 per ton. The output during the period under consideration was 1,700,268 kw-hours, and the maximum output in any one day was 17,610 kw-hours. The load factor was 19.4 per cent, which, with the modern equipment and load coal cost, secured excellent station economy. The operating expenses for the half year are as given in the table.

COST OF PRODUCTION AT BINGHAMTON PLANT, LAST HALF 1907.

Station labor and superintendence, .252 ct. per kw-hour, or	$4,298.75
Fuel, .54 ct. per kw-hour, or	9,186.92
Oil and waste, sundries	807.99
Building repairs	1.99
Repairs, motive power	222.04
Repairs, electrical equipment	92.27
Repairs, station sundry equipment	97.86
Total, .87 ct. per kw-hour, or	$14,707.82

Railroad Company Compelled to Maintain Telephone Service.

The citizens of Skedee, Okla., filed a complaint against the Atchison, Topeka & Santa Fé Railway Company to compel the railroad to become a subscriber of the local telephone exchange and to install an instrument in its depot at Skedee. The complaint alleged that many persons receiving consignments of freight from time to time resided at a distance from the railroad depot and were compelled, under existing conditions, to depend upon the mails for notification of freight on hand for them, a system which often resulted in delay and even in the payment of demurrage. The real objection of the railroad company to becoming a telephone subscriber does not appear in the case, but in their answer the attorneys for the company set forth as the only reason for not having a telephone the fact that it would cost the company $2 a month, notwithstanding that the cost of notifying receivers of freight by mail would exceed $2 a month. It was held that under the constitution of Oklahoma, authorizing the Corporation Commission to require railroad companies to establish and maintain all such public service facilities and conveniences as might be reasonable and just, the commission was warranted in requiring the company to install telephone service. As to the telephone the court, quoting from People's Telephone Company vs. Eastern Railway Company of Minnesota (decided by the Railroad Commission of Wisconsin, Oct. 12, 1908) said: "The telephone is at present an indispensable aid in the conduct of almost every business and calling of any importance. No railroad company could manage its business at any center of population economically or satisfactorily without telephonic connections between its stations, warehouses and grounds and the mercantile, manufacturing and other places of business in the community. The duty of furnishing the public with adequate telephonic service for the purpose of transacting business with the railroad has been self-imposed in many instances by reason of usage and necessity. It has, therefore become a necessary facility in such cases for the proper discharge of transportation business of the railway company, within the rule of the common law as well as in contemplation of the express legislative enactments. While a carrier may select the agencies by which to serve the public, it may not select an agency exclusively which for any reason is incapable of fully discharging the duty of the carrier to the public. The right of selection of facilities is limited by the condition that those selected are adequate and efficient for the purposes required."

Fleming on Wireless Telegraphy.

In an address delivered before the Royal Institution, London, June 5, Prof. J. A. Fleming gave a popular exposition of the latest advances in wireless telegraphy. In opening he outlined the functions of the antennæ in radiating and absorbing the electric waves employed in radiotelegraphy. It had long been known that radiotelegraphy was conducted with greater facility over sea than over land, and the first part of the lecture was an exposition of recent investigations into the causes of the difference. It was shown by a simple experiment with iron, copper, and galvanized iron spirals, that a zinc-covered or galvanized iron wire conducted high-frequency oscillations almost as well as a copper wire, but that if the zinc skin was burned off the wire then acted as an ordinary iron wire.

This proved that the high-frequency currents were confined

to a surface skin. The penetration into the metal was greater the worse the conductivity. The same was true of electric waves passing over the earth. They penetrated into it and dissipated their energy. In the case of sea water, the penetration of waves 1000 ft. long was about 4 ft. or 5 ft., but if propagated over very dry soil, the penetration and, therefore, loss of energy was much greater. Curves were exhibited derived from a recent research by Dr. Zenneck, of Brunswick, showing the relative effect of sea water, fresh water, damp soil, and dry soil, on the depth of penetration.

It was shown that for a certain soil conductivity represented by very dry sand, the abstraction of energy from a wave of 1000 ft. in length was a maximum. The superior facility of transmission over sea water was as much due to its high dielectric constant as to its good conductivity. Some questions were next discussed connected with new modes of setting up oscillations in the antennæ. A new form of oscillograph vacuum tube was exhibited, the invention of Dr. Gehrcke, by means of which it was possible to examine and analyze optically the oscillations existing in a wireless telegraph circuit.

Photographs of oscillations taken by this means by Dr. Diesselhorst at the Berlin Reichsanstalt were shown. It was proved that when the oscillations in the antennæ or radiating wires were produced by the inductive action of other oscillations in a coupled condenser circuit, the result was to radiate from the antennæ waves of two-wave lengths. In general only one of these was utilized, but the lecturer described means by which both waves could be absorbed and made effective. The method due to Wien of quenching the primary spark so as to prevent this reaction of one circuit on the other was then described, and new methods of exciting the oscillations in the antennæ due to recent German discoveries were explained and illustrated.

The property of certain types of antennæ of radiating waves more strongly in some directions than others, was then discussed. The interesting inventions of MM. Bellini and Tosi for locating the direction of the sending station were described. In the next place new oscillation detectors or devices for detecting electric waves were described. Mr. Walter's tantalum detector, consisting of a fragment of tantalum wire out of an incandescent lamp dipping into mercury, was mentioned. The new crystal detectors, such as Dunwoody's carborundum detector and Pierce's anastase and molybdenite detectors, were exhibited and worked.

The curious and marked property of carborundum and molybdenite of conducting electricity better in one direction than another was discussed and its application to the construction of wireless telegraphic receivers explained. Dr. Fleming then exhibited experiments with a new detector of his own, consisting of an incandescent lamp with a metallic filament of tungsten having a copper cylinder around, but not touching it. When the filament was in action the space between the filament and the copper possessed a unilateral conductivity, and like the crystal detector this glow lamp detector could be used to receive radiotelegraphic signals. It was a detector of great sensibility.

Finally a reference was made to the problem of wireless telephony. It was shown that by means of the recently invented oscillation detectors, articular speech and not merely signals could be transmitted, provided that the radiating antennæ were made to radiate persistent or undamped waves. Some of the newer methods of producing these oscillations were considered, including the high-tension aluminium arc of Ernst Ruhmer.

CURRENT NEWS AND NOTES.

NEW N. E. L. A. COMPANY SECTIONS.—Company sections of the National Electric Light Association have been organized at Baltimore, Md., San Antonio, Tex., and Salt Lake City, Utah.

MICHIGAN ELECTRIC ASSOCIATION CONVENTION.—The 1909 convention of the Michigan Electric Association will be held at Detroit, Aug. 17, 18, 19. Mr. A. C. Marshall, of Port Huron, is secretary.

SHOW-WINDOW ILLUMINATION.—Some photometric measurements of show-window illumination recently made in Denver gave a mean illumination of 10 ft.-candles at the window as viewed from the outside, and a maximum of 17.7 ft.-candles.

ARMY WIRELESS TELEPHONE.—According to advices from Washington, the War Department, through the Signal Corps, is putting up a mast on the Mills Building annex there and another at Fort Myer, five miles away, for the purpose of trying out wireless telephony as a preliminary step to tests at longer range.

PATRICK CALHOUN JURY DISAGREES.—The jury in the trial of Patrick Calhoun, president of the United Railways Company, on a charge of bribing San Francisco supervisors, failed to reach an agreement and was discharged. The trial has been going on since January. It is said that 10 of the jury stood for acquittal and two for conviction.

MASSACHUSETTS ASSOCIATION OF MUNICIPAL ELECTRICAL INSPECTORS.—At the recent annual meeting of the Massachusetts Association of Municipal Electrical Inspectors Mr. Walter B. Randlett, of Newton, was elected president, and Mr. William Lincoln Smith, of Concord, secretary-treasurer. Messrs. James E. Cole, of Boston, and Eugene N. Davis, of Brookline, refused re-election to these respective positions, which they had occupied since the organization of the association.

A. I. E. E. FRONTENAC CONVENTION.—On and after June 30 there will be a through passenger service to Frontenac, Thousand Isles, where the A. I. E. E. convention will be held the latter part of June. A sleeper will leave New York (New York Central) at 7:15 p. m. daily, arriving at Clayton at 6:28 a. m. and connecting with a steamer leaving there at 7:10 a.m., arriving in Frontenac at 7:20 a. m. There will also be a parlor-car service on a train leaving New York at 7:45 a. m. daily except Sunday, arriving at Clayton at 5:10 p. m., and connecting there with a steamer arriving at Frontenac at 5:20 p. m.

CHICAGO SECTION ILLUMINATING ENGINEERING SOCIETY.—The last meeting of the Chicago section of the Illuminating Engineering Society for this season was held at noon on June 17 in the Great Northern Hotel. There was a good attendance, and the meeting was prolonged for three hours. On the report of a nominating committee, the following officers were elected for the ensuing year: Chairman, Mr. Albert Scheible; secretary, Mr. T. R. Beebe; managers, Messrs. J. R. Cravath and E. W. Lloyd. The speaker of the occasion was Mr. Albert Frank Horton, of the Electric Shop of the Commonwealth Edison Company, who delivered an illustrated lecture on artistic interior lighting, particularly relating to fixtures. Mr. Horton displayed a number of lantern-slide pictures contrasting the effect of good lighting and bad lighting.

MANUFACTURE OF CALCIUM CARBIDE.—At the International Congress of Applied Chemistry, held in London recently, Mr. Samuel R. Tucker presented a paper dealing with "The Relative Efficiency of the Arc and Resistance Furnace for the Manufacture of Calcium Carbide." Calcium carbide was prepared in two types of furnaces under conditions which would give the best yield, and comparisons made of the product as to its carbide content and its weight obtained per energy unit. The results showed that, for the scale on which the experiments were conducted, the resistance furnace was much superior to the arc. The best result obtained with the arc furnace was 1170 watt-hours per 100 grams of pure carbide, while with the resistance furnace the same quantity of pure carbide was obtained with 544 watt-hours.

LARGE ORDER FOR RADIUM.—A special dispatch from London states that an order has just been given for radium to the value of $150,000 by Lord Iveagh and Sir Felix Cassel for an institute recently founded by them for the investigation of cures for cancer. Possibly Sir Ernest Cassel is meant. The quantity is said to be a little less than a quarter of an ounce, which would make the market price of radium about $8,000,000 a pound, troy weight.

N. E. L. A. NATIONAL SPECIAL SESSIONS.—At the Atlantic City N. E. L. A. convention a new article was added to the constitution of the association providing for national special sessions, which may hold their meetings at other times than during the annual convention. The formation of such sessions will be authorized upon the application of 10 Class A (central station) members. While the new article specifies special sessions of lawyers, accountants, engineers, purchasing agents or commercial men, its terms authorize the similar organization of other classes connected with the conduct of central-station business. All members of the special sessions must be members of the N. E. L. A.

WISCONSIN SUMMER ELECTRICAL CONVENTION.—The Wisconsin Electric and Interurban Railway Association and the Northwestern Electrical Association will hold a meeting at Grand View Hotel, Chain o' Lakes, Waupaca, Wis., June 28 and 29, 1909. This meeting will give an opportunity for an enjoyable outing combined with business. It is expected to have papers or addresses on legislation, purchasing of coal, and other subjects. Both associations are composed mainly of electric railway and electric lighting companies in Wisconsin. Mr. Clement C. Smith, Stevenson Building, Milwaukee, Wis., is secretary and treasurer of the Wisconsin Electric and Interurban Railway Association, and is making the arrangements for this joint meeting.

BOILER FIRING.—The best treatise thus far printed on boiler firing has been issued by the United States Geological Survey in Bulletin No. 373, with the title "The Smokeless Combustion of Coal in Boiler Plants; With a Chapter on Central Heating Plants." The pamphlet comprises 188 pages, of which 88 deal with boiler plants with mechanical stokers, and 40 with hand-fired furnaces. Both of these sections are accompanied with illustrations of furnaces, and with tables of data of some hundreds of mechanically and hand-fired plants. The final section contains data relating to 57 steam and hot-water central heating plants. The practical and other information contained in the bulletin will be found invaluable by all interested in fire-room economy, entirely aside from the question of smokeless combustion.

GERMAN ELECTRIC LIGHTING TAXATION.—Some months ago the finance committee of the German Reichstag rejected a Government proposal for taxing the consumption of electricity. Recently, however, the same committee has presented a bill of its own providing for a similar system of taxation, whereby incandescent and glow lamps, arc-lamp carbons, mercury-vapor and other lamps would be taxed. The tax on incandescent-filament and glow lamps ranges from 5 cents per lamp for lamps between 25 watts and 60 watts, to 12 cents for lamps of 100 watts or over. The tax for arc-light carbons is 11 cents per pound, and for mercury-vapor and similar lamps 25 cents per lamp up to 100 watts, and 25 cents extra for each excess of 100 watts or portion thereof. Mantles for incandescent gas and similar lamps are taxed at 2½ cents per lamp. The tax is to be paid by manufacturers by the employment of revenue labels attached at the factory, or by importers on clearing from the custom house or within three days after.

PROPOSED PUBLIC UTILITIES COMMISSION FOR INDIANA.—The recent contention between Governor Marshall and the Indiana Railroad Commission over the power of the commission, will, it is believed, give rise to a strong movement to have a public utilities law passed by the Legislature similar to that in several other States. It is pointed out that the powers of the present commission are, by law, practically confined to the fixing and regulation of freight and passenger traffic on steam and interurban roads, preventing discrimination and compelling the interchange of traffic between railroads. It is claimed the commission has gone farther and farther beyond its functions; and while it has done many things, steam and interurban roads, though not admitting the commission had the power to make certain orders, have obeyed them because the suggestions were good ones. It is now proposed to enact a public utilities law that will control not only railroads, but include the tax board, the labor commission, factory inspector, central station, electric railways, telephone and similar public services.

UNLOADING PASSENGERS IN ELEVATED-RAILWAY ACCIDENTS.—The Northwestern Elevated Railroad in Chicago, having had an unfortunate experience in several recent accidents, has issued instructions to prevent delay to passengers in case of future accidents. Trainmen are instructed in case of delay or blockade to have one train go ahead or back up to a station platform. Adjacent trains are to pull up close to the first one so that passengers can step from one car to the other and thus reach the station platform. Where it is necessary to transfer passengers from the middle or express-train tracks to local station platforms, the express train is to be pulled up alongside of the train standing by the platform track. The two trains are to be connected by one or two bridge planks long enough to fit from one car to the other. Each station is to be provided with two bridge planks of this description placed in receptacles on the front of station platforms. By this means it is planned to provide an easy exit for passengers and to prevent them from alighting from the cars to the structure, obviating the possibility of stepping on the third-rail.

REMINISCENCES OF OTHER DAYS.—Owing to the illness of Mr. Forée Bain, there was no regular speaker at the meeting of the Electric Club of Chicago on June 16. Mr. Bain's subject was to have related to the early days of electrical development, and President Howlett said that in his absence he would call on some of the members of the club to talk informally on the same subject. Mr. W. D. Ray, of the Sanitary District, spoke of the old Edison station at 139 Adams Street and referred to the interest excited by the experimental electric railway in the old Exposition Building on Michigan Avenue some 22 years ago. Those were the days, he said, of "undertakers' wire." Mr. Donald M. Carter, now a lawyer, gave some amusing reminiscences of the building of an isolated plant in the Grand Central Railroad station which "acted up" just at the time a large party of railroad officials made a formal inspection of it. Mr. John W. Mabbs, chief engineer for the Board of Trade, said that he worked for the M. C. Bullock Company, which put in the first electric lights in Chicago back in 1880 or 1881. These were Brush arc lamps and were installed in the old Exposition Building like the electric railway to which Mr. Ray referred. Speaking of incandescent lighting, Mr. Mabbs said that the first switchboard in the Board of Trade plant was made of maple flooring and was considered to be rather fine. Mr. A. L. Millard, of the Westinghouse Electric & Manufacturing Company, told of the starting of the Cicero & Proviso Electric Railway in the western suburbs of Chicago some 20 years ago. Those were the days when 7½-hp railway equipments were sold for $4,800 and "something in common stock." Mr. Millard recalled several amusing incidents connected with that installation. Mr. Albert Scheible could remember the time when 16-cp incandescent lamps were sold for 60 cents each. When the price was suddenly dropped in 1891 to 44 cents, it was thought that a revolution had been accomplished in the electric-lighting industry. It was decided that the club should have a picnic to which ladies would be invited on July 17 at some place to be selected by the entertainment committee. A baseball game, fat-men's race, swimming race and other pastimes will be features of the outing.

Electricity at the Harvard College Observatory.

By HOWARD S. KNOWLTON.

IN the research work of the modern laboratory, electricity is one of the most important aids to investigation. The delicacy, accuracy and flexibility of electrical methods are unsurpassed, and nowhere do these advantages appear more clearly than in the astronomical observatory. Until quite recently the uses of electricity in this field have been largely confined to the transmission of time signals in some form or other between observatories and outside points, the furnishing of time intervals to local apparatus within the observatory walls, various applications of electric lighting, and telephone service. In a few cases electric power has been used for the winding of weights operating clockwork for telescope driving. Within the past two years, however, the problem of applying the motor drive directly to the telescope has been solved at the Harvard College Observatory in Cambridge, Mass., and the success attained indicates that electricity will play an important part in future work of this character. In the following paragraphs some of the principal applications of electricity at the Harvard College Observatory will be described, this particular installation being selected on account of the fact that electrical methods have been more completely worked out here than in any other existing astronomical research station.

FIG. 1.—POWER ROOM.

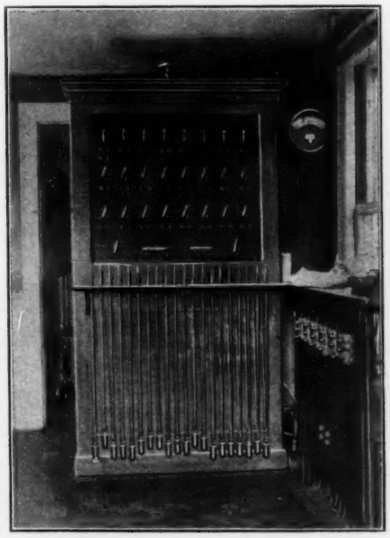


FIG. 2.—SWITCHBOARD FOR SIGNALING SERVICE.

The supply of energy for the different applications of electricity at the observatory is derived from the local central-station company. In one wing of the laboratory building a room has been set apart for the introduction and control of the power supply. The lighting of the different buildings on the property is handled by a 110-volt alternating-current service taken from a standard transformer. The power service is derived from the regular 500-volt, direct-current lines of the Cambridge Electric Light Company, but the various motors are operated at 110 volts, direct current, through the medium of a motor-generator installation in the observatory power room. The distances of transmission about the grounds are short and the service essentially intermittent. The signaling work of the observatory is handled by storage batteries, and there has been adopted recently a standard potential of 8 volts for all electromagnetic apparatus. The present installation of separate storage batteries is now being centralized in a single battery-room. The use of this standard voltage will increase the flexibility of all the signaling equipment, and enable the complete advantages of the unit principle in arrangement and combination to be enjoyed. Special care has been taken at the observatory to sectionalize the various circuits in such a way that the maximum number of experimental combinations can be secured without interrupting apparatus in service.

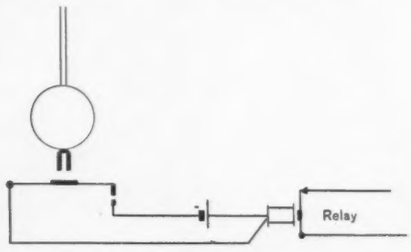


FIG. 3.—CLOCK-CONTACT SCHEME.

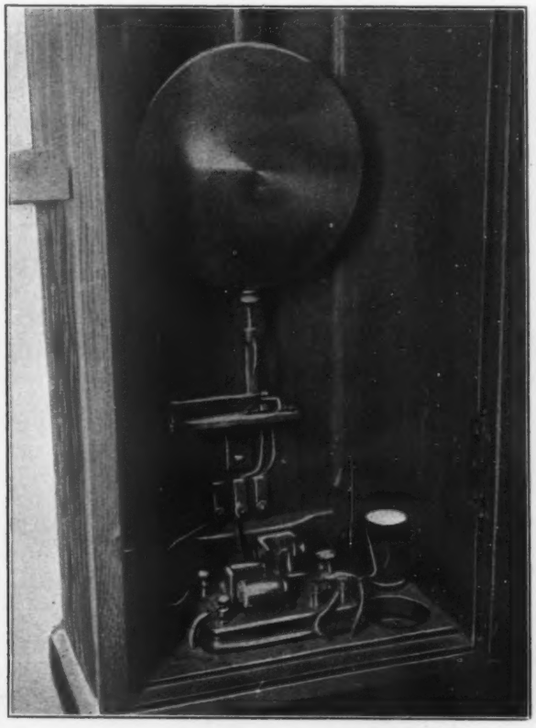


FIG. 4.—PENDULUM CONTACT ARRANGEMENT.

The power-room contains a 110-volt, alternating-current lighting panel board, with meter, fuses and knife switches; a 500-volt, direct-current panel, with similar equipment; a 500/110-volt Crocker-Wheeler direct-current motor-generator set; a 110-volt power-service switchboard panel with controlling

switches and combination volt and ammeter, and a 5-hp, 500-volt Crocker-Wheeler motor driving through a lineshaft and belting an adjoining shoproom equipment; and a shunt-wound Edison bipolar dynamo having a potential range of 25 volts to 125 volts, used exclusively for storage-battery charging. There are also several motor-starting boxes located at this place, and the wiring is so arranged that the motor-generator set can

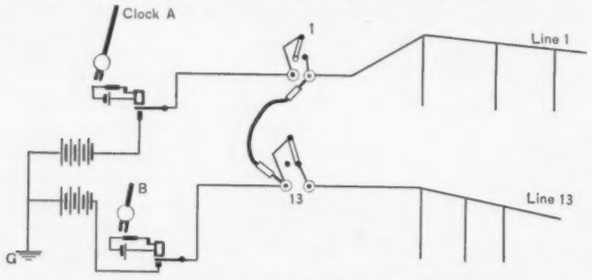


FIG. 5.—TRANSFER OF CLOCK SIGNALS.

be started from a distance when desired without the necessity of anyone entering the power-room.

A separate room is provided in the laboratory building of the observatory for the manufacture of time signals and their distribution throughout the premises. A bank of clocks, the majority of which have pendulums with a period of one second, is mounted on the wall of this room, and close by is a switchboard controlling 24 circuits which run to various points on the grounds. By means of this switchboard any clock can be connected to any of the outgoing circuits and its impulses electrically transmitted to any apparatus that may be in need of such service. The contacts which the clock pendulums make are entirely without friction, the scheme used being illustrated in the accompanying drawing (Fig. 3). Attached to the bottom of the pendulum is a small steel horseshoe magnet, which passes close above an armature at every swing. The armature is mounted upon a small spring which is fitted with a platinum tip at its end, which makes a contact with a platinum stop piece all the time except when the pendulum is directly over the armature. As the pendulum reaches the middle of each swing, it pulls the armature and spring away from the platinum stop, breaking the circuit of a sensitive relay, which in turn sends a corresponding electrical impulse through the main circuit leading to the switchboard and apparatus which happens to be connected at the time. The absence of friction and the location of the armature directly beneath the center of gravity of the pendulum enable the electric contacts and breaks to be made

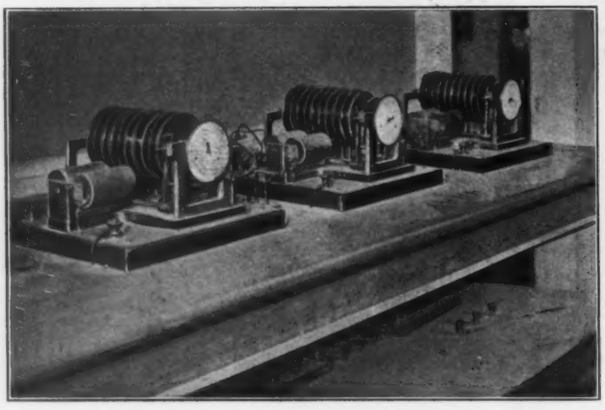


FIG. 6.—PROGRAM INSTRUMENT.

with the least possible interference with the accuracy of the clock mechanism.

The general arrangement of the switchboard includes a pair of jacks in each principal circuit and a two-point switch which closes or opens the path between the two jacks. At the bottom of the board is provided a row of flexible cords with plugs at their ends, the cords being used as jumpers between any of the jacks desired when it is necessary to combine different circuits or to substitute the signals of one clock for those of another on a line which is in service. The flexible cords resemble those used in telephony, except that each line consists of a simple loop with one plug at each end. Further flexibility is secured by the connection of several relay contacts with corresponding cords, enabling the functions of different actuating mechanisms to be exchanged with the utmost freedom. The sketch (Fig. 5) illustrates in diagrammatic form how one clock may be substituted for another on a time-signaling circuit. Here, clock *A*, for example, has been supplying circuit 1 with signals at two-second intervals, while clock *B* has been furnishing line 13 with signals at one-second intervals. Assuming that one-second signals are desired on line 1, the switch 1 is thrown off and a flexible cord introduced into the jacks as shown, leaving the switch of line 13 intact. Both lines now receive signals every second from clock *B*. If desired, a cord can be inserted in the left-hand jack of the switch 1 and carried to any other terminal on the switchboard where signals are desired at two-second intervals without interfering in any way with the operation of the circuits 1 and 13. These circuit arrangements are not complex, but they illustrate the principle of unit operation which is carried out through the entire plant. Maximum independence of all apparatus results from the establishment of permanent terminals on the switchboard. In addition to the contacts shown in the sketch, blank contact bars are provided, with suitable holes drilled in the metal, so that any two cords can be joined in case of necessity without uncertainty or delay. No temporary twisting of wires or establishment of irregular and loose connections is required with this arrangement.

Mounted on the table in the switchboard-room just mentioned are four program instruments which can be set to furnish signals at any interval which is a multiple of the primary

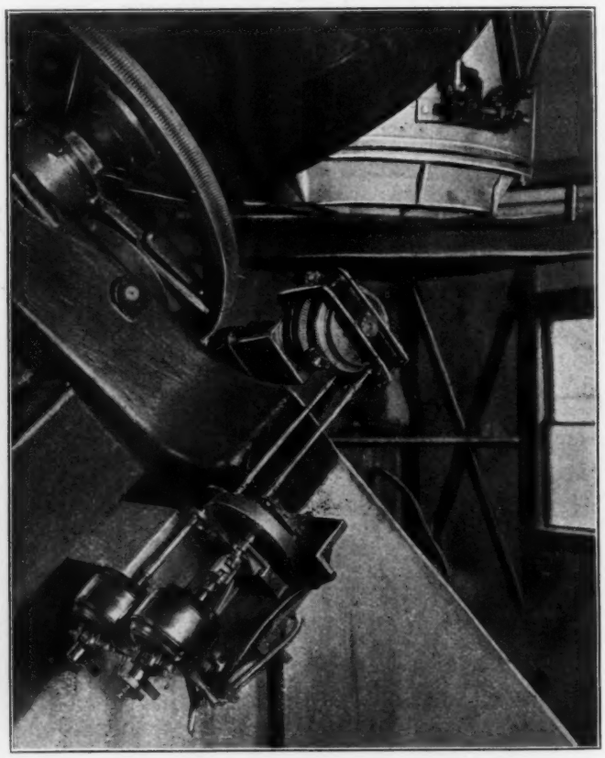


FIG. 7.—MOTOR DRIVE OF 24-IN. TELESCOPE.

impulse applied to the driving mechanism. Each instrument consists of a spindle carrying a row of parallel brass disks or contact cams driven by an electromagnet. The electromagnet may be connected with one of the clocks or any other impulse-providing circuit-closer. When impulses are admitted to the magnet of a program instrument every second the row of contact cams makes one complete revolution in a minute. Ac-

cording to the number of notches on the disks of the individual cams, that number of contacts will be made per revolution, and in the case above cited, with a cam having four notches spaced evenly around the circumference of the disk, a signal will be sent out from the cam every 15 seconds. The next cam, for example, may have five regular notches on its surface, and the impulses which it permits will pass out every 12 seconds. Each

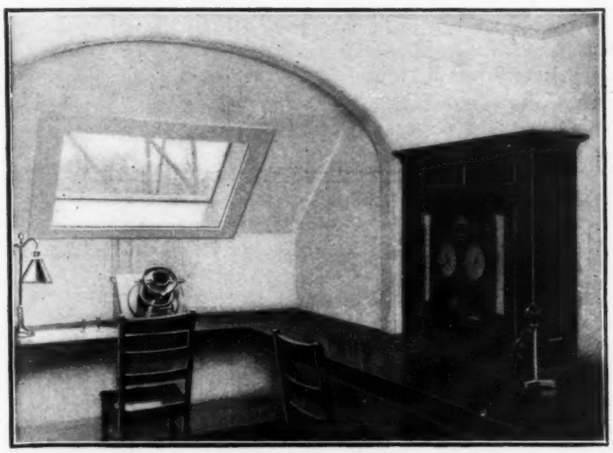


FIG. 8.—OBSERVING-ROOM 60-IN. TELESCOPE WITH CONTROLLING SWITCHBOARD.

cam contact is made mechanically, no current passing in or out of the disks. For each cam is provided a terminal connection on the base of the instrument, so that the circuit-closing im-

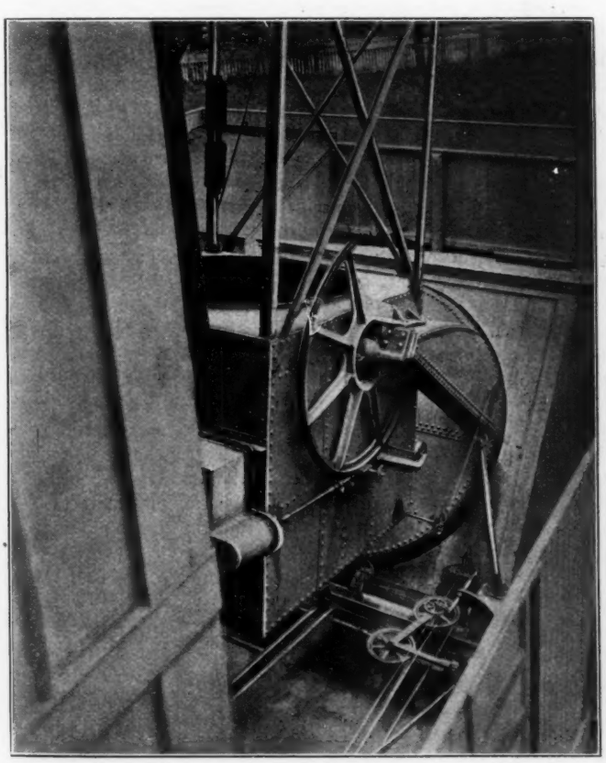


FIG. 9.—60-IN. COMMON TELESCOPE SHOWING METHOD OF DRIVING IN RIGHT ASCENSION.

pulses from any one or group of cams may be transmitted to any desired point. The cams are detachable, and the observatory has a large collection of disks milled to give different time intervals which have been found desirable in its work. By using three of the program instruments in series and connecting the driving magnets so that one will make one complete revolution and contact in 24 hours, the second one revolution contact per minute, with the third making a contact every second it is easily possible to pick out any second of the day and obtain a signal from the apparatus at that time and at no other. Such a signal can then be transmitted to any point in the observatory where it may be needed. By the use of the proper cams the most irregular combinations of signals can be made and repeated at predetermined intervals. The separation of the different cam circuits on the same program instrument again illustrates the independence of similar parts, which permits so much flexibility in the conduct of experimental work at this observatory.

Aside from the above signaling apparatus, the observatory is provided with a complete fire-alarm system, with repeating boxes giving numbered calls for the different stations on the premises. A private telephone system is also in service between the different buildings and departments. Among the other minor uses of electricity may be mentioned the illumination of transparencies and the application of miniature incandescent lamps to instrument fields in setting cross-hairs on stars. The observatory library contains a number of photographic positives of different constellations and heavenly bodies, with views of the Arequipa branch of the observatory, in the Peruvian Andes. These plates are mounted on the sides of a room which can be darkened easily, and behind the transparencies are mounted incandescent lamps in such a manner that when the current is applied in the darkened room the natural appearance of the sky is reproduced and the beauty of the transparencies much heightened.

The most advanced electrical applications at the observatory are in the field of telescope driving. The old method of driving telescopes automatically, and the one still followed elsewhere, is by the so-called driving "clock," which is a more or less intricate system of weights, levers, springs and gears,

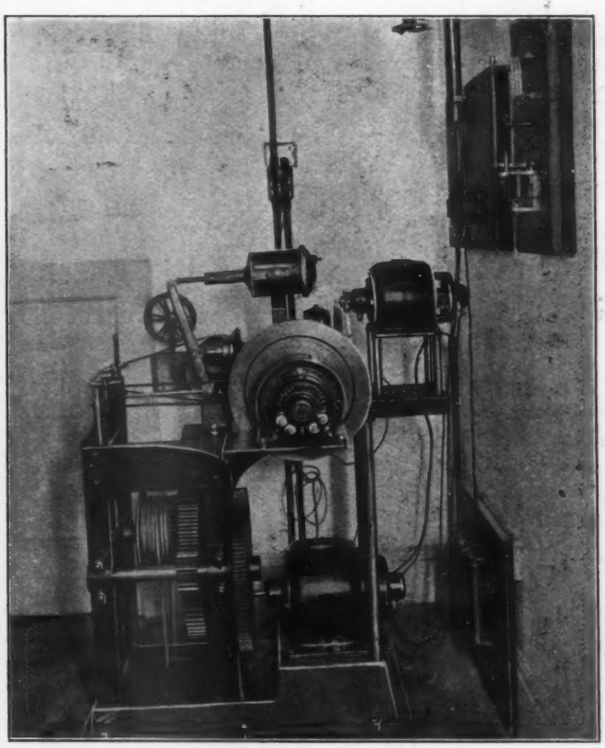


FIG. 10.—DRIVING MECHANISM FOR 60-IN. COMMON TELESCOPE.

operated by gravity after suitable winding has been effected. This apparatus is costly, liable to derangement, and subject to inaccuracies, requiring the most careful attention. With the electric drive, however, the cost is moderate, the mechanism comparatively free from disturbing complications and the control entirely automatic. The first telescope in the world to be driven by an electric motor was a 24-in. reflector belonging to this observatory. This instrument is illustrated in the ac-

companying Fig. 7, the method of driving being shown. Two motors are provided, one for giving the telescope a comparatively slow motion, and the other for keeping it pointed to any star with automatic compensation for the motion of the earth on its axis. The driving is accomplished by means of a plant wheel and bevel gearing, so that both motors can be in operation at once without interference, the resultant motion of the telescope being the algebraic sum of the movements imparted by the motors. In normal operation the right-hand motor shown in the photograph is the only one in motion, power being applied to it at intervals of one second for a length of time determined by an automatic governor mounted on the driving mechanism. The success of this application was so immediate that the principle was adopted for the driving of the 60-in. Common reflecting telescope, lately purchased by the observatory from the heirs of the English astronomer of that name. This instrument is one of the two largest in the world, and in the new electrical system of control which has been applied to it all of its motions, forward and backward, in right ascension and declination, are operated by independent motors.

The polar axis of the Common telescope is floated in a tank of water instead of being supported by a pier of masonry or steel, as in the usual installations. The entire telescope weighs about 22 tons. The accompanying Fig. 9 shows the frame of the instrument, with the floating tank and sector which moves it in right ascension, and a small railroad track below upon which a car is run carrying the principal mirror, the weight of the glass being about 1200 lb. and its value approximately $15,000. The lens is housed in the building adjoining when the instrument is not in service. The reflected rays from the heavenly body under observation are thrown into the house

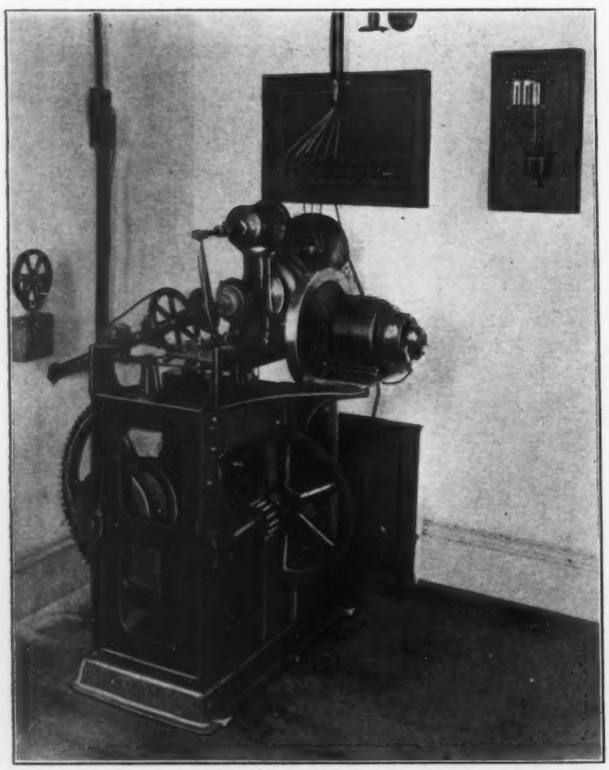


FIG. 11:—END VIEW OF DRIVING MECHANISM OF 60-IN. COMMON TELESCOPE.

by appropriate mirrors, and the observer carries on his work in a comfortable room, shown in illustration (Fig. 8), all motions of the telescope being readily controlled by switches mounted on a table at the observer's right. The movement of the telescope in right ascension is effected by a motor installed to give it a rapid motion through a drum and steel cables, and also through a sector, not shown in the illustration, which may be driven slowly by a separate motor or in synchronism with an astronomical clock through an automatic governor and relay circuit. The exact position of the telescope in both right ascension and declination is indicated on two scales shown in the observing-room photograph above the table where the operating levers for the telescope are located. These scales are moved by piano wires attached to the telescope, the wires being installed on drums with a sheave and weight compensation which maintains a constant length of wire under all conditions of position and temperature.

The mechanism by which the Common telescope is driven is

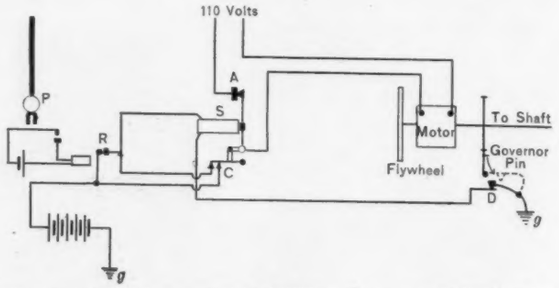


FIG. 12.—METHOD OF SYNCHRONIZING 60-IN. TELESCOPE DRIVE.

shown in Figs. 10 and 11. Five motors are installed. For movements in declination two motors are mounted in a box on the outside of the frame. One is a 1/16-hp motor in a ¼-hp frame, for slow motion, and the other is a ¼-hp motor in a ¾-hp frame, for fast motion. Inside the building is the main driving machinery for right ascension movements. For giving the telescope fast motion either with or against the rotation of the earth, a ¼-hp motor in a ¾-hp frame is provided. The drive is through gearing and a windlass, shown in the illustration, the motor being the one mounted on the bottom of the machine frame. The slow motions of the telescope in right ascension are handled by a 1/16-hp motor in a ¼-hp frame, shown in the uppermost corner of the machine. The motion of the telescope in synchronism with passing heavenly bodies is effected by a ⅛-hp motor in a ¼-hp frame. This motor is provided with a flywheel, shown in the illustration, and it, together with the slow-motion motor, drives the telescope by means of a planetary and bevel-gear combination leading ultimately to the main steel driving shaft of the reflector. Near the top of the machine is a solenoid which cuts out the slow-motion and synchronized-motor gearing when it is desired to turn the sector of the telescope back to zero, and outside the building a similar solenoid disconnects the sector from the telescope. When the observations have ceased on any given object, it is expedient to bring the sector back to zero to allow for two or three hours' forward run, on other work, and the accomplishment of this task by the clock-motor through a belt tightened by the solenoid, while the telescope is being turned by the windlass motor, illustrates a convenience which would be difficult to obtain in any other way than by electricity.

The vital part of the problem of telescope driving is the question of governing the motion to secure practically perfect accuracy of rotation as the earth revolves away from the object under observation. This is accomplished by synchronizing the governor with the controlling clock. The general arrangement of the apparatus is shown in the above sketch (Fig. 12). Current to the motor is supplied by the 110-volt circuit through the contact *A*, which in reality consists of six breaks of ⅛ in. each in series. The switch *A* is operated by an electromagnet *S* in an auxiliary circuit of low potential supplied by a battery. This auxiliary circuit also includes a contact *R* operated by a relay in the circuit controlled by the pendulum *P*, which makes one vibration per second, and a releasing contact *D* or governor, which is momentarily opened at each revolution by a wheel in the telescope machinery, which should, when driven at the proper rate, revolve one turn per second. The relay contact *R* is provided with a locking contact *C* so arranged that when the circuit through the magnet *S* is once closed by the clock

contact *R* it cannot be opened except by the releasing contact *D* on the governor.

The method of operation is as follows: The clock pendulum closes the auxiliary circuit through the magnet *S*, the armature of which turns on the power at the motor. The motor frames are larger than necessary to enable the machines to start without rheostats. The motor starts and accelerates until the telescope is moved far enough to operate the releasing pin on the governor wheel, when the power is cut off at *A*. The machinery continues its motion by virtue of its inertia, to which is added that of the motor flywheel. The clock again closes the circuit on the return of the pendulum, and the cycle is repeated, with impulses applied each second. If the telescope should run a little too fast, the interval between the closing of the circuit by the clock and its opening by the governor wheel pin decreases, and a correspondingly shorter interval of power is applied, causing an immediate reduction in speed. If the speed of the telescope is too low during any given second, the interval of power application is correspondingly increased and the speed increases. The governor with the aid of the flywheel soon establishes a mean speed which corresponds exactly to the beats of the pendulum, and the small variations which occur during the second intervals are too minute to be appreciable.

The above work has been done under the general administration of Prof. E. C. Pickering, director, by Mr. Willard P. Gerrish, mechanical and electrical engineer of the observatory, who is the designer of the apparatus here described.

Auxiliary Steam-Driven Electric Station at Rome, Italy.

By S. B. Jones.

THE greater part of the electricity used in Rome, Italy, at the present time, both for lamps and tramways, is furnished from three plants of the Società Anglo-Romana per l'Illuminazione di Roma. Two of these are hydraulic and one steam. The largest is situated at Tivoli, about 28 km from the city, and has an output of 12,000 kw at 10,000 volts. Further into the mountains, at Subiaco, is the second hydraulic plant with two 3500-kw generators, and generating 30,000 volts direct. The third and oldest, a steam plant, is within the city walls and on the site of the ancient Circus Maximus. In this plant are four 850-hp non-condensing reciprocating engines, direct connected to alternators wound for 8800 volts. The system throughout is operated at approximately 44 cycles. At the peak of the load the machines are speeded up to give better regulation in the city. For various reasons, among which is the desire of the authorities to continue the archæological exploration in this direction, the company decided to change the position of the steam plant and to enlarge it at the same time. Since the steam plant had always been used as a standby for peak loads and in case of trouble, the construction of a modern plant in a location allowing for expansion was decided upon, this course permitting the old station to be kept in readiness.

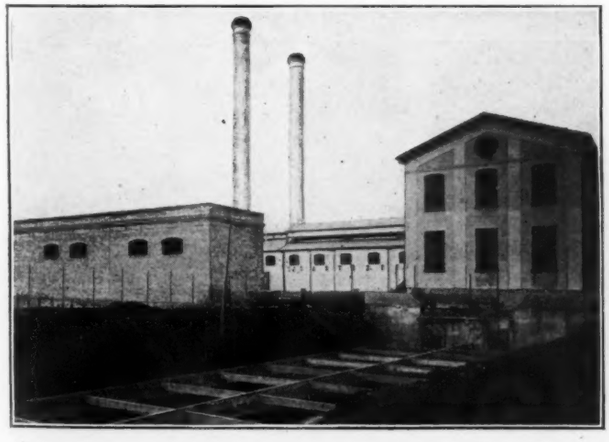


FIG. 1.—GENERAL VIEW OF POWER HOUSE AND INTAKE CANAL.

The site of the new plant is on the bank of the Tiber between the city wall and the church of San Paolo. Being on the river and near the railway, coal can be brought to the power house either by water or rail, since the Tiber is navigable for coal barges to this point. At present the coal is brought up the river and discharged into small cars on a temporary railway running to the coal-storage building. The building itself runs parallel with the engine-room, the boiler-room being at right angles to the engine-room and extending toward it. The inside dimensions are; Length, 148 m (485 ft.); and width, 16 m (52 ft.), which allows a depth of coal of about 6 m (19.6 ft.) over the entire floor. Commanding the floor is an electric bridge crane with a clam-shell bucket. The crane discharges the fuel into the filling bin which feeds it into a bucket chain conveyor. The conveyor passes through a tunnel for about 10 m (32.8 ft.), and then rises vertically to a level above the ash-bin and storage-bins in the boiler-room. Passing to the back of the engine-room, to the driving gear and motor, it drops vertically to the cellar and runs horizontally to the storage building, completing the cycle. When not in use for handling coal, the conveyor is used to discharge the ashes, which are shoveled into the conveyor on its way through the cellar. At normal working

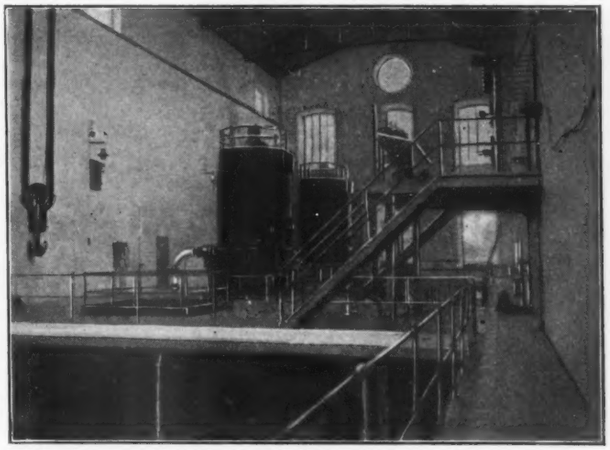


FIG. 2.—GENERAL VIEW OF ENGINE ROOM.

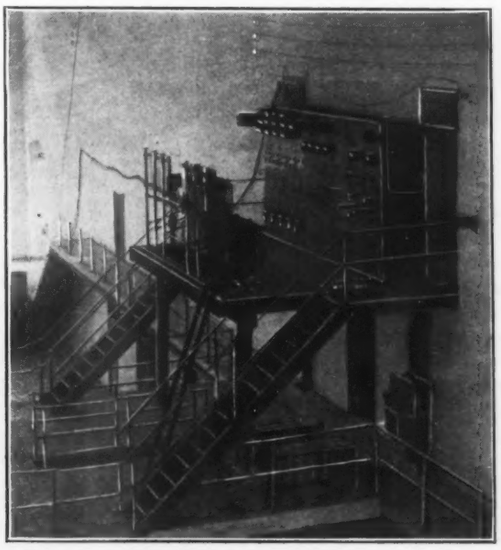


FIG. 3.—SWITCHBOARD GALLERY.

the conveyor will handle approximately 30 to 35 tons of coal per hour.

The storage-bins in the boiler-room are directly over the firing aisle between the two rows of boilers. From these bins the coal goes into mechanical stokers furnished by the Düsseldorf Mechanical Stoker Company. The stokers are of the top-feed type, the movement of the coal being produced by the grate bars moving alternately outward and then altogether inward, the rate of feed being controlled by changing the speed on cone

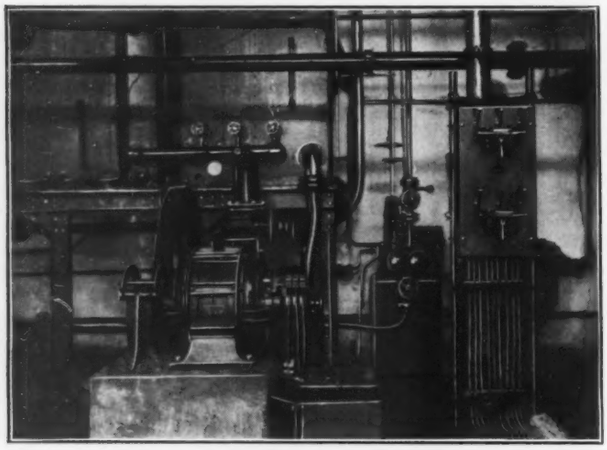


FIG. 4.—OIL PUMPS AND FILTER.

pulleys. The grate bars extend the length of the furnace, and have a surface of 6.5 sq. m (69.5 sq. ft.). For smokeless combustion the boilers are furnished with "Dutch ovens."

The boilers are of the water-tube type, furnished by Clarke, Chapman & Company, Gateshead, Eng. There are six batteries at present, three batteries on either side of the boiler-room, two boilers to the battery, with ample space between batteries to allow for cleaning, and between rows for a firing aisle. Each boiler is designed to evaporate 5000 kg (11,025 lb.) per hour, and has a sufficiently large superheater installed in each setting to give steam at 300 C. at full load on boiler. The boilers differ somewhat from the ordinary type of water-tube boiler. They resemble the Stirling type, but have six steel drums, three above and three below. All the vertical tubes are straight and are arranged under manholes in the top drum in elliptical nests, so that it is possible to remove any tube without disturbing any of the others by removing two manhole covers.

Running around the boiler-room is a 10-in. closed circuit header of rectangular shape, with a steam separator at each of the angles next the engine-room, and an 8-in. tap running to the turbines in the engine-room. On each of the connections between the boilers and the header are two valves, a gate valve next the header, and a non-return valve next the boiler to prevent the pipe from filling with water when cut out of service. In the header itself are valves for sectionalizing it. The valves throughout are of cast steel with brass gates, and are made with the gate of reduced area—that is, the area of the passage through the valve is reduced to one-quarter of the area of the pipe, the approach and discharge being designed to give theoretically the least resistance to the steam. On valves with steam flowing only in one direction, the inlet angle is wider than the outlet, but where the valve is used for steam passing in both directions both sides are equal and of the same angularity as the discharge of the other valves.

Under normal conditions the feed water for the boilers is taken from a small stream flowing through an underground canal near the plant. In dry weather it may also be taken from the Tiber or the city water mains. The water is taken from the river to two tanks mounted on steel towers at each side of the boiler-room, by means of two single-stage centrifugal pumps, direct-connected to motors. From the tanks the water passes through two filters to the boiler-feed pumps. The latter are five-stage, centrifugal pumps and each is large enough to feed all the boilers. In addition each boiler is fitted with an injector. Before entering the boilers, the water goes through Green fuel economizers. The gases from the boilers after passing through the economizers follow a concrete breeching to the stacks at the end of the boiler nearest the coal storage. Each row of boilers discharges into a separate concrete stack 55 m (180 ft.) high and 3 m (9.8 ft.) internal diameter. Between each stack and boilers is installed an induced draft fan, which under normal conditions is cut out; but when forcing fires for a quick start, or under heavy overloads, it may be cut in by dampers. For sampling the gases a CO_2 apparatus permanently connected to all boilers is used.

The engine-room is 60 m (196.8 ft.) long and 14 m (46 ft.) wide, with space for 20,000 kw of electrical equipment. At present there are two 3500-kw units installed, leaving space for about 13,000 kw more. The two present units consist of Curtis turbines direct connected to 3500-kw, 8800-volt, three-phase alternators, giving normally 42 cycles, but with a governor allowing regulation from 40 to 44 cycles. The turbines take steam at 275 deg. C., 12-kg (170 lb.) pressure.

The condensing equipment of each turbine consists of a surface condenser with the necessary circulating and wet vacuum pump. The circulating pump is direct connected to an induction motor. The wet vacuum pump is belted to an induction motor. The circulating water comes from the Tiber through two intake canals, which may be used separately or together, or as a cooling tank by taking from one and discharging into the other; the discharge water normally returning to the Tiber through a tunnel. Since the canals are above the level of the river, the water is lifted by two single-stage centrifugal pumps in a pump-house near the river. Each pump has a capacity of 1500 cu. m per hour against a 7 m head. The pumps are vertical and direct connected to induction motors. On leaving the condenser, the circulating water is discharged through a tunnel to the river. In order to get full advantage of the vacuum due to the draft tube formed by the discharge of the condenser, an air trap is fitted on the top of the discharge of the condenser for removing any air that might become entrained in the circulating water. In starting the air is removed by a steam injector, but after the air pump is started the injector is cut off and the pump takes care of the air by means of a small pipe fitted for the purpose.

The oil for the middle bearing, top bearing and governor of the turbine is furnished by two electric and one steam pump at 10 kg (142 lb.) pressure, any one of the pumps being large

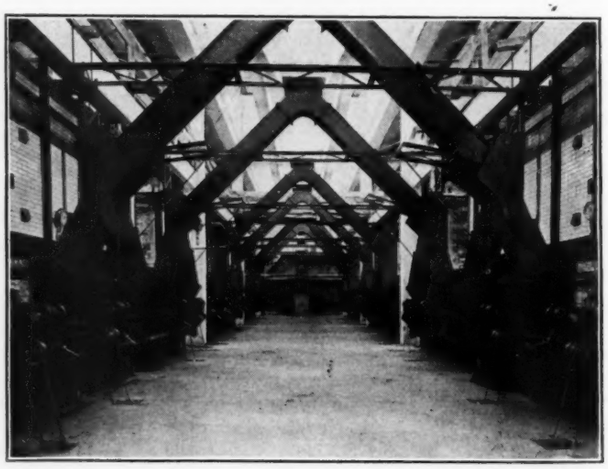


FIG. 5.—BOILER-ROOM SHOWING AUTOMATIC STOKERS.

enough for both machines. The oil for the step bearings is furnished by two electric and one steam pump at 55 kg (782 lb.) pressure, each pump being of sufficient size to care for both machines. Although the steam pump is arranged to start automatically, for greater safety an accumulator is also used, having sufficient capacity to furnish oil for both machines for

five minutes. Each oiling system has a combined Turner oil tank and filter. Within each tank are a set of coils for cooling the oil, and the cooling water after passing through the coils goes to the hot well. The motors for the induced draft and stoker pumps are direct-current machines operating either from the exciter circuits, or in case of absolute shutdown of the other stations, from storage batteries. This method is used so that the plant can be put into commission at any time without external power. The storage battery furnishes excitation for the alternators also when starting. The other auxiliaries throughout are driven by three-phase, 220-volt induction motors with external resistance in the rotor. The direct-current motors were furnished by the General Electric Company, and the induction motors were supplied by the British Thomson-Houston Company.

On a gallery near the center of the engine-room are the switchboards. The benchboard is on the front of the gallery overlooking the generators; the exciter and feeder board being at the back of the gallery next the wall. The benchboard is of blue Vermont marble. Two panels on each end control four alternators, two already installed and two future units. The center panel carries the control switch for paralleling the two sets of busbars, and indicating lamps showing how many feeders are connected and to which set of bars. The vertical board is of blue Vermont marble also, and is made up of 10 three-section panels; five panels carry control switches for feeders, four control outgoing feeders and one controls the auxiliaries within the station. The feeders to the city take a current of 8800 volts.

The station feeder connects to three single-phase transformers stepping down to 220 volts. One panel is a combination booster and battery panel, with direct-current feeders to the induced draft fan and stoker pumps. Two panels control the exciters, only one pole being brought to the switchboard; the remaining panel is blank and is intended for a future exciter. The excitation of the alternators is controlled from the generator panels on the benchboard, through remote-control field switches and solenoid-operated rheostats. A Tirrill regulator with connections for four alternators is mounted on a bracket at the end of the benchboard. On the basement floor beneath the switchboard are placed the exciters and booster. The exciters are motor-generator sets. The motors are rated at 135 hp, 220 volt, alternating current; the generators are rated at 90 kw, 125 volts. For charging the storage battery a motor-generator booster set is installed alongside of the exciters. The motor is a 125-volt, direct-current, variable-speed machine, and the generator is rated at 400 amp and 55 volts.

Immediately back of the switchboard are the oil switch, busbar, storage battery and transformer rooms. The 8800-volt oil switches are motor operated. Below the switches are the busbar-rooms with two entirely separate sets of busbars installed in concrete cells, with their sectionalizing and disconnecting switches. Adjoining this room on the right is the transformer room for the station service, also the low-tension switchboard for supplying the individual apparatus. Each motor or group of motors in the station has its own panel with ammeter, voltmeter or indicating lamp, and three-pole circuit-breaker. The wiring for the engine-room auxiliaries runs beneath the floor in troughs, and the wires for the boiler-room and other auxiliary apparatus are run overhead. Further to the right of the transformer room is the storage-battery room. The storage battery consists of 66 elements with a capacity of 400 amp-hours.

The feeders for the city run underground, three-phase, lead-covered cables with steel armor being employed. They are laid in trenches with no further protection than a thin creosoted wooden box. The joints are made with cast-iron junction boxes and filled with compound. The feeders for the pump-house at the Tiber are of the same type, but carry low-tension current. All of the switchboard, including the oil switches and individual panels, was furnished by the General Electric Company, the engineers and contractors being the Cie, Française Thomson-Houston.

The Design and Operation of Jump-Spark Coils.

BY F. W. SPRINGER.

SOME of the points involved in the design and operation of jump-spark coils have been touched upon in former articles[1] by the present writer. The article below represents an attempt to distinguish between the "arc" and the "spark" as generated by jump-spark coils of the vibrating and non-vibrating types.

In order to investigate all of the factors concerned, the com-

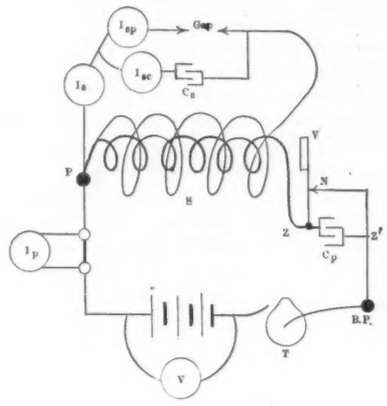


FIG. 1.—VIBRATING JUMP-SPARK CIRCUITS.

plete cycle of events occurring during the operation of a coil will be enumerated.

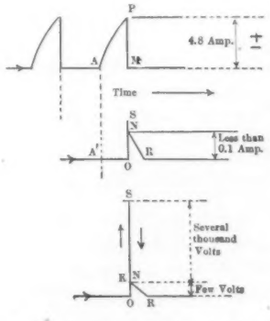
A diagrammatic sketch of the common vibrating jump-spark coil is given in Fig. 1. By eliminating the condenser C_p and vibrator V, there would be obtained the common non-vibrating coil. In the latter case a condenser C_p should be connected around the timer T.

The data given with the figures are those of the Loiseaux Brunet Frères coil, which have been previously described in these columns.[2]

The cycle of events is as follows:

The current, I_p, rises in the primary on the curve AP (Fig. 2). Generally this curve will be nearly straight, as it should be in order to obtain a high core charging efficiency.

The counter e.m.f. generated during the increase in current, I_p, will be a maximum at A (Fig. 2). At this point it will just



FIGS. 2, 3 AND 4.—PRIMARY CURRENT, SECONDARY CURRENT AND SPARK VOLTAGE.

equal the battery voltage. Since the total lines of force also cut the secondary coil of Ns turns, the e.m.f. in the latter will be equal to the battery voltage multiplied by $Ns \div Np$.

The secondary e.m.f. occurring at A^1 (Fig. 3), etc., will usually be of the order of 500 volts, which is not sufficient to jump any ordinary spark gap, but it will cause a surge of current in

[1] *Electrical World*, Dec. 8 and 29, 1906; Dec. 14, 1907.
[2] *Electrical World*, Dec. 8, 1906.

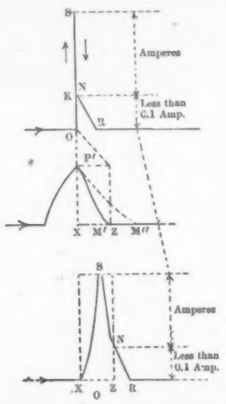
the secondary coil, S, charging the spark terminals, etc., as a condenser.

There should result a surge in the secondary circuit whose effects will be $I^2_s R_s$ losses and a tendency to cause the primary current to build up on a more nearly vertical line; that is, to reach its full value more rapidly. There may be several surges as the voltage falls, but they will be of high frequency and correspondingly weak.

At P, Fig. 2, the vibrator (or timer) opens the circuit, the primary current, falling on the line PM. If there is no arcing at the vibrator (or timer) the flux will decrease at a maximum rate near point P, Fig. 2. The sudden change in flux will produce a high voltage E_s in the secondary coil S, and establish the secondary, or spark, current ONR, Fig. 3. The secondary voltage curve will be as indicated in Fig. 4, OSN (double line) being the jumping voltage and ONR the potential between the spark points which maintains the "arc."

Since the spark points are first statically charged by the voltage OS, Fig. 4, the static discharge current, or the "spark," may be shown as $OKSN$, Fig. 5.

If the vibrator opens with no arcing—that is, with an absolutely instantaneous break—the primary current will fall on a line, PM, Fig. 2, which corresponds to a charging curve of a condenser. If, then, we imagine the time of PM to be widened



FIGS. 5, 6 AND 7.—SPARK RECORD, TIME OF BREAK MAGNIFIED AND STATIC DISCHARGE MAGNIFIED.

to XZ, Fig. 6, to represent perhaps millionths of a second, while AM represents thousandths of a second, Fig. 2 will appear as Fig. 6.

If there is arcing at the vibrator, or if a primary condenser of very large capacity is used, $P'M'$ might appear as is shown by the dotted line $P'M''$. In this case the form of PM would be affected by the secondary coil conditions.

By widening OKS of Fig. 5 in a similar way, XSN of Fig. 7 is the "spark" and ZNR is the "arc" of the secondary current, shown by $OSNR$ of Figs. 3 and 5.

The condenser C_p will be charged at $P'M'$, Fig. 6, by a pressure of the order of 100 volts and about equal to the battery voltage plus $\frac{N_p}{N_s}$ times the secondary voltage OS, Fig. 4, although it is possible that this pressure will not be maintained long enough on XZ, Fig. 7, to charge the condenser fully.

Since at some point below P, Fig. 2, the secondary current is established, the primary ampere turns, $N_p I_p$, are replaced by $N_s I_s$, and the discharge of the electroc-magnetic energy $\frac{L_p I_p^2}{2}$ of the core takes place in the secondary coil on the line NR of Fig. 5. During or immediately following the discharge the charge in the primary condenser C_p is released, and flows back through the battery, etc.

If the secondary gap is too long to be jumped, all the secondary magnetic energy will appear only as static electricity, which will charge the spark points and wires of the secondary coil and then surge back and forth until frittered out. At the same time the charge in the condenser C_p will also surge in the primary coil, the primary and secondary surges affecting each other in a way depending upon the natural resonance periods of the two circuits. A primary coil back surge charges the battery.

If the secondary coil has no gap, being short circuited, a secondary current will be produced, both during the make and break, of practically the same quantity, although of differing half-wave forms. (See *Electrical World*, Fig. 5, p. 1242, Dec. 25, 1906.) There will be no static charge in this case in the secondary circuit.

It is to be noted that XSN of Fig. 7 represents the static discharge in the spark-gap of the "spark," OS representing the maximum spark current in amperes. ZNR is the "arc"that follows. The first is so rapid as to be detonative in character and has a value depending on the capacity of the condenser C_s or upon the capacity of the spark-gap, etc.

Beginning at some point on XS, Fig. 7, a brush discharge occurs, the gap becoming filled with ionized particles, which finally establish a "spark" at S, liberating the static energy. The electromagnetic discharge then follows. The part XSN is too rapid to be recorded by the oscillograph, while NR lasts a few thousandths of a second or until the arc breaks at R. When the arc breaks no doubt there is some energy still in the core. This energy is frittered away by primary and secondary coil surges, which are damped by the copper, iron and condenser losses of the primary and secondary circuits.

Repeated oscillograph and other tests of many spark coils lead the writer to believe that the conditions mentioned in connection with PM and ON above, Figs. 2 and 3, are very important ones in the design and operation of spark coils. All electrical, magnetic and physical constants and their inter-relations are involved therein. For instance, the capacity of the condenser C_p affects the character of the spark by its back surge, as well as enabling the spark to be produced by allowing the vibrator to open without arcing. Upon the capacity of the condenser depends also the rapidity with which the primary current I_p is stopped, and thus also the maximum value of the secondary voltage E_s.

An interesting accident led to the study of the static discharge. Most of the records of the writer were made by means of a Duddell oscillograph, which has metal fuses. Several years ago a General Electric instrument was put into service on spark-coil tests because it was more easily adjusted than the older type. Gold-foil fuses on paper were used in series with the oscillograph strips. These would not last long enough to obtain a record of the secondary or spark current, burning up in one or more seconds, and stopping the secondary current by introducing a large gap. This current was measured at I_s, Fig. 1, and the fuse burning occurred in spite of the fact that the current actually recorded by the primary-coil galvanometer was several times as large; also notwithstanding that the fuses carried 0.5 amp direct current without burning out. The latter test was made at 500 volts with a lamp resistor.

A special test of gold-strip fuses, placed in clamps and connected in series with an adjustable spark-gap connected to the secondary of a Loiseaux coil operated by three storage cells, gave the following results:

With spark-gaps varying from 0.3 in. to 0.02 in., the fuses burned in a few seconds after starting the coil, the flame beginning at either end, depending upon the direction of the secondary current. The length of time required to burn the fuse varied with the length of the spark-gap, and some other conditions not as yet understood.

When the spark-gap was closed so that there was no storage of static charges the fuses lasted indefinitely, showing no signs of burning, although the average current, as recorded by the oscillograph, was found to be many times as large as when the spark-gap was open. On opening the spark-gap slowly while the coil was in operation, it was found that the fuse also held indefinitely, until the spark reached a length of approximately 0.02 in., with the particular coil and existing conditions.

In an endeavor to explain the burning of the fuses, all previous spark records were studied to find out whether there had

been a ballistic throw of the oscillograph. Out of more than 100 records, two plates were discovered which showed a faint line at *SN*, Fig. 3. One of these plates was made with a Duddell and the other with a General Electric oscillograph, using the same spark coil (Loiseaux Brunet Frères). Any very wide movement of the strip and mirror at a speed approaching that of its natural period (5000 to 8000 per second), such as that caused by a large momentary current, would not be likely to be seen at all on the plate, and it required some imagination to see the ballistic record on the two plates above. This result will be referred to again later.

The energy appearing in the spark-gap may be classified as follows: 1. Brush discharge. 2. Spark or static discharge, like that from a Leyden jar. 3. Arc or electromagnetic discharge. 4. Heat energy from the brush, static and arc discharges. 5. Electromagnetic wave, as in wireless telegraphy, largely from the static discharge. 6. Sound wave, largely from the spark (2) above, consisting of a very short, dense wave, spreading out from the gap like an enlarging shell.

It should be evident that, by the use of a variable secondary or spark-gap condenser, C_s, Fig. 1, connected in parallel, and by varying the length of the gap, the form and characteristics of the spark-gap energy may be varied at will as follows:

(a) A long spark-gap and a condenser C_s of as large a capacity as may be used without absorbing all of the spark will produce a brilliant white, *fat-appearing* spark and giving forth much sound.

Its duration is so brief that its image cannot readily be spread out when viewed in a revolving mirror. Blowing upon it has no effect. It will not readily ignite paper, but will explode or burst holes in the paper. It is estimated by Thomson that the pressure in the path of a "spark" is more than 660 atmospheres. This is due, no doubt, to the sudden heating of the medium in the spark path and to the pinch effect of the magnetic lines of force.

Investigations have been made along these lines during the past three years in order to devise a spark coil to be used with a spark recorder (*Electrical World*, July 21, 1906, page 134). With certain coils, a short gap and a condenser C_s of large capacity, spark records have been obtained which a blind man could interpret. Resonance is not necessary to obtain these results.

(b) With the proper adjustment of the capacity of the condenser C_s, consisting of a few square inches of tin-foil on opposite sides of window glass, resonance sparks may be produced. Sometimes five or six may be counted in a rocking or revolving mirror. These sparks will have the characteristics of the static sparks mentioned above, the total energy being divided among a number of sparks.

(c) If no secondary condenser is used, and especially with a rather short gap, an arc will occur lasting several thousandths of a second. This "arc" is violet, yellow and red in color, much less brilliant than the "spark" noted above, and when its image is viewed in a revolving mirror it appears spread out into a long band of flame. It is greatly changed by blowing upon it. It will readily ignite paper—that is, it burns, but does not explode the holes. In general, this "arc" has the characteristics of the common direct-current arc.

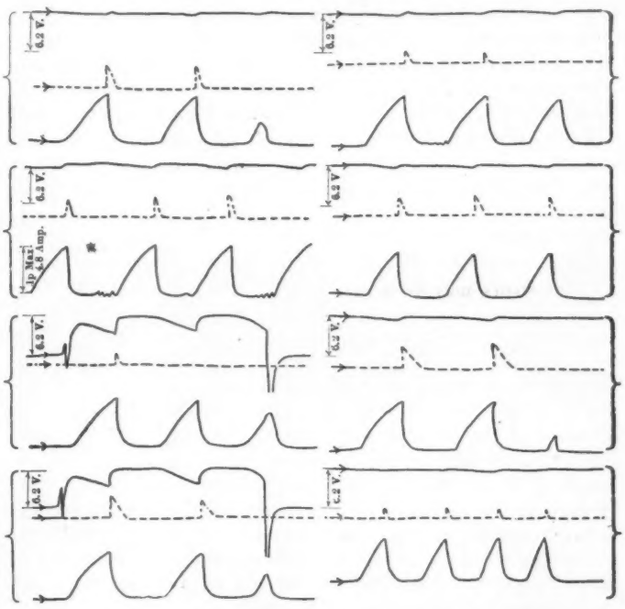
A number of oscillograms were made, shown in Figs. 8, 9, 10, 11, 12, 13 and 14, using the Loiseaux coil with parallel secondary condensers about the spark-gap, a three-cell storage battery and different lengths of spark-gap. Fig. 15 was obtained with a series condenser, the capacity of which was adjusted to produce resonance. There were between 100 and 125 vibrations per second.

In the accompanying oscillograms, Fig. 8 shows the battery voltage, the spark current and the primary current, the arrangement used being that indicated in Fig. 1; the spark-gap measured 0.25 in. and the secondary capacity zero. Fig. 9 refers to conditions similar to those of Fig. 8 except that the secondary capacity C_s had the value given by a condenser formed of two conductors 20 sq. cm in area separated by window glass. In Fig. 10 the condenser area was increased to 50 sq. cm; the e.m.f. in this case was measured between *P* and *BP*, Fig. 1. In Fig. 11 the capacity was decreased to zero and the spark-gap was decreased to 0.05 in. Fig. 12 shows the results for conditions similar to those of Fig. 11 except that the condenser had an area of 25 sq. cm. In Fig. 13 the spark-gap was decreased to 0.004 in. and the condenser area was increased to 670 sq. cm. Fig. 14 was obtained when the capacity was zero and the spark-gap length 0.004 in. Fig. 15 shows the results when the secondary condenser was given such a capacity as to produce resonance.

A study of the spark records shows that the shorter the gap, the larger will be the recorded electromagnetic discharge (longer and higher records); and the larger the capacity of the secondary condenser C_s, the less will be the secondary *recorded* current.

A few calculations were undertaken in order that the maximum static discharge current *OS*, Fig. 7, might be estimated, as follows:

The time, *XZ*, must be less than the width of the line *ON*, *PM*, etc., or of the order of 0.000001 second. The maximum voltage *OS*, of Fig. 4, may be taken in an illustrative case as 6000 volts. The secondary capacity might be, for example, 0.00001 microfarad or more. The resistance of the spark varies



FIGS. 8, 9, 10 AND 11.—OSCILLOGRAMS.

FIGS. 12, 13, 14 AND 15.—OSCILLOGRAMS.

from infinity at *X* to a few ohms at *Z*, Fig. 7. According to Slaby, the resistance of a 3-mm spark-gap is 2.3 ohms. On the basis that the time record of a spark should be as shown in Fig. 5 and illustrated in Fig. 7, the secondary energy *J* may be divided into two parts, as illustrated in Fig. 7, into the "static," C_sE^2max

$$J_{cap} = \frac{C_sE^2max}{2} = \frac{6000^2}{2} \times \frac{0.00001}{1{,}000{,}000}$$

$$= 0.00018 \text{ joule or watt-second.}$$

Since $$J = I_{av} \times t \times \frac{E_{max}}{2}$$

then $0.00018 = I_{av} \times 0.000001 = \frac{6000}{2}$ and $I_{av} = 0.6$ amp, and the maximum secondary current, I_s, would be much larger.

Again, since the discharge of a condenser when time *t* equals zero, gives $I = \frac{E}{R}$ where *I* is the initial discharge of the condenser as at *OS*, Fig. 7, and *E* is the maximum voltage *OS*, Fig. 4, there results $I = \frac{6000}{R}$. Inasmuch as the gap is broken down at this point, *R* is small, thus making *I* very large. This

current is that in the gap and not necessarily in the secondary coil.

There seems to be little *experimental* evidence as to which form of energy is the most efficient in ignition. In regard to a pure static discharge, everyone is familiar with the ignition of a gas flame by rubbing the feet on the carpet and permitting a spark to jump from one's finger to the fixture. Moreover, it is well known that a Leyden jar discharge will blow grains of gunpowder to pieces without igniting them, and that they will be ignited if the discharge is passed through a wet string of high resistance. Lightning strokes similarly have great explosive and bursting power, but generally fail to ignite solid combustibles, although an electric arc of small power and energy will generally do so.

Just what relative igniting effect *XSZ* (Fig. 7) has as compared to that of *ONR*, is thus not absolutely known. It would seem, however, that a very explosive mixture would respond to the detonative effect of *XSZ* and that a weak mixture would be more readily ignited by energy in the form of a slow arc (0.001 second) as *ONR*. Therefore, in a gas engine a *hot arc* is what is desired and not a brilliant and apparently hot, fat "spark"; the hot arc should, however, be bunched as much as possible.

A very excellent conception of the distinctions noted above may be obtained by watching the image of the spark in a rapidly rocking mirror or in a cube-shaped mirror mounted on a motor-shaft. One may also use a double-plane mirror mounted across the diameter of rotation and perpendicular to the plan of rotation, meanwhile varying the length of the spark-gap, with and without different amounts of series and parallel secondary capacity. The length, size, shape, colors, amount of flame, noise, amount of ozone generated, brush discharge, ability to puncture paper, and whether holes are burned or burst out, ability to ignite the corner or middle of a sheet of paper, oscillations of the spark, duration of the spark and arc, and other characteristics may be noted.

The length of the arc may be determined by a micrometer-screw fitted with conical-shaped brass spark-points. The amount of flame may be determined by color of the arc, by blowing upon it while viewing it in a mirror rocked rapidly by hand, or by using a mirror mounted on a motor-shaft. The duration of the arc and spark, and the presence of oscillations, can be determined by the use of the revolving mirror. If the speed of the mirror is known, the duration of the visible arc in seconds may be calculated, or in case of resonance, the time between sparks may be measured and the frequency calculated.

Another simple way to determine the duration of the "arc" is to mount the spark-gap on the end of a revolving wheel spoke, thereby noting its apparent length.

DESIGN AND RESONANCE.

If the vibrator opens the primary circuit instantaneously at P, Fig. 2, the core will be charged with $J_p = \frac{LI^2}{2} = 0.048$ watt-second or joule of energy, and the circuit will be as shown in Fig. 16. If there be no secondary coil, the above magnetic energy will be changed to dynamic energy which will charge the condenser C_p. Assuming that there are no appreciable hysteresis or eddy currents in the core, no copper losses in the coil P and circuit, and no dielectric losses, the 0.048 watt-second will appear as static energy.

$$J_{cap} = \frac{CE^2}{2} = 0.048 = \frac{0.16\,E^2_p}{2{,}000{,}000}$$

from which $E_p = 784$ volts.

Another way of calculating the maximum primary e.m.f. is:

$$E_p = I_{max}\sqrt{\frac{L}{C}} = 4.7\,\frac{\sqrt{0.0043}}{\frac{0.16}{1{,}000{,}000}} = 722 \text{ volts.}$$

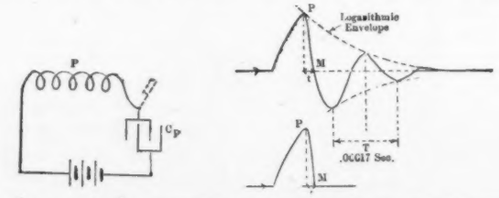
This static energy again changes to the current form, then into magnetic energy with $I_p = 0$, etc., surging back and forth indefinitely. The battery e.m.f. affects the form of the surge waves slightly.

If, however, there is resistance in the coil and circuit, iron and dielectric losses, some of the energy will disappear during each surge, as in Fig. 17. All causes of loss of energy may well be expressed as an *equivalent resistance, R_p*. From the standpoint of design, the above losses during one surge should never exceed a small per cent of the total energy.

The period T_p of the above resonance surges may be readily calculated from the simple equation $T_p = 2\pi\sqrt{L_pC_p} = 0.00017$ second, shown in Fig. 17. The frequency, $f = \frac{1}{T} = 6020$ complete oscillations per second, which is rather too high for the ordinary oscillograph.

If the equivalent resistance, R_p, of the above primary circuit is such that R is greater than $\sqrt{\frac{4L}{C}}$, or if R_p is greater than 316 ohms, the surge will be unidirectional and the primary current will continue in the same direction, dying out without passing through zero. A secondary coil would absorb energy from the primary during each surge, and would, therefore, act as an equivalent resistance R_p in the primary circuit, as in Figs. 2 and 18.

Referring again to Fig. 17, it is seen that if the frequency f be made very great and T very small, then the speed of cutting lines of force, shown by time t, will be great. The problem then is to reduce t to as near nothing as possible and to have a unidirectional half-surge, as shown in Fig. 18. Moreover,



FIGS. 16, 17 AND 18.—CIRCUITS AND OSCILLOGRAMS FOR RESONANCE.

large losses in the primary circuit are not permissible so that R_p should represent only the absorption of energy by the secondary coil.

Since the self-induction L_p of the primary coil is fixed by considerations taken up in previous papers, concerning I_p and J_p, or the energy of the spark, it is evident that f cannot be increased except by reducing the capacity of the primary condenser C_p. This, however, cannot be done without arcing at the vibrator, which would tend to prolong the surge or increase t. Hence, there must be more speed in the vibrator in order that C_p may be reduced and f increased.

The above discussion regarding the capacity of C_p also applies to the use of a condenser, C_p', in parallel with the timer of a non-vibrating coil. Hence, a snap-break timer, with a condenser, should be used on motor cycles with a non-vibrating coil for high battery efficiency.

With the above desirable features in the primary coil, it would require comparatively few turns (N_s) on the secondary to cause a spark to jump the gap. The resistance R_s could be made small, and practically all of the energy, transferred to the secondary coil as dynamic energy, would appear as heat in the spark-gap.

$$E_s = E_p\,\frac{N_s}{N_p} = E_p\,\sqrt{\frac{L_s}{L_p}} = 722\,\sqrt{\frac{20.8}{0.0043}} = 50{,}000 \text{ volts,}$$

a voltage which is practically unattainable because of the *slowness* of the break at the vibrator. About 15,000 volts were obtained from the coil used by the author. A vibrator should be designed which would open with the speed of a rifle bullet.

SECONDARY-COIL RESONANCE.

By placing a condenser C_s consisting of two sheets of tin-foil, each approximately 25 sq. cm in area, on opposite sides of a sheet of glass of about 0.25 cm in thickness, in parallel with the spark-gap, resonance sparks were produced.

$$C_s = \frac{KAN}{4\pi d\,900{,}000} = \frac{7 \times 25 \times 1}{4\pi\,0.25 \times 900{,}000} = 0.00006 \text{ mf.}$$

The secondary capacity which would produce resonance of

the same frequency (T_p) as that of the primary circuit of the coil is calculated thus:

$T_s = 2\pi\sqrt{L_s C_s}$, from $2\pi f L = \frac{1}{2\pi f C}$, which is the condition for resonance for a frequency f.

$$0.03017 = 2\pi\sqrt{20.3}\, C_s$$
$$C_s = 0.00004\ mf.$$

This capacity is so small as to be comparable with the capacity of the secondary windings, spark coils and spark points.

CONCLUSIONS.

The method of designing spark coils have greatly inmproved during the past few years, mainly by securing a more rapid break, as by using hammer blows, vibration waves in a thin metal spring, etc. It would seem from the considerations of the above conditions that, by the use of a single spark and a still more rapid break, the spark-coil efficiency might easily be increased to 50 or 60 per cent.

Long Distance Transmission in Wisconsin.

The Southern Wisconsin Power Company is hurrying to completion its hydro-electric generating station near Kilbourn on the Wisconsin River, and its 110-mile, 66,000-volt transmission system for supplying energy to the 13,200-volt distributing system of the Milwaukee Electric Railway & Light Company. It is probable that the installation will be completed and in operation during this month.

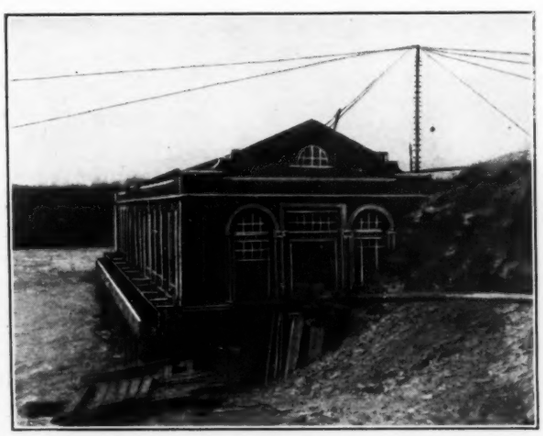


FIG. 1.—KILBOURN HYDRO-ELECTRIC POWER HOUSE.

The generating equipment at the Kilbourn plant comprises four 2300-volt, three-phase, 25-cycle alternators having an aggregate rating of 10,000 kw. These machines, with the transformers for raising the e.m.f. to 66,000 volts, and the auxiliary electrical apparatus, are of General Electric manufacture.

The transmission circuits consist of six wires having the equivalent conductivity of a No. 0 copper wire. One-half of the conducting material is copper and the other aluminum. The two three-phase circuits are erected in separate vertical planes, being suspended by Thomas disk-type insulators from cross-arms on Aermotor steel towers. The height from the ground at the lowest wire is 40 ft. The towers are of the lattice-work windmill type erected on four reinforced concrete bases. A view of the transmission line erected along the route of a railway system to which it feeds energy is shown herewith.

The substation for lowering the e.m.f. from 66,000 to 13,200 volts for the Milwaukee system will contain six 2000-kw Allis-Chalmers transformers. The energy will be employed for supplementing the present supply from the steam-engine-driven generating station in Milwaukee. One of the uses to which this energy is now being put is the operation of a single-phase, 25-cycle railway. This railway is now being equipped with 1200-volt, direct-current apparatus, the energy for which will be obtained through 600-volt, rotary-converters connected in series. Both the older and the new equipment were built by the General Electric Company, which suggested the change from single-phase to direct current.

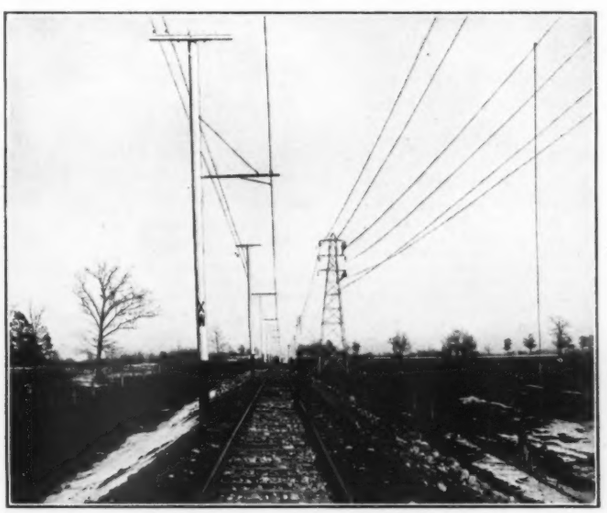


FIG. 2.—DOUBLE THREE-PHASE 6600-VOLT TRANSMISSION LINE AND RAILWAY CIRCUIT.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Shop Window Lighting in Fort Smith, Ark.

At the May meeting of the Associated Retailers of Fort Smith, Ark., the question of window lighting was taken up, with the result that a resolution was adopted to the effect that all members of the association should light their windows at dusk and keep them lighted until 11 or 12 o'clock. Owners of some of the larger stores spoke very strongly in favor of this resolution, giving results of their own experience in window lighting. The resolution was adopted unanimously, and a committee appointed to interview Mr. J. Walter Gillette, manager of the Fort Smith Light & Traction Company, in regard to securing a flat rate upon this class of lighting. The attractive appearance of stores in other large cities is responsible for this effort of the merchants of Fort Smith to bring their city up to the highest possible standard of decorative illumination. It is felt that decorative window displays and increased installations of electric signs will attract the people to the main streets in the evening and result in a largely increased business for the merchant, as well as stamping those promoting the scheme as champions of a more beautiful and desirable city.

Electric Street Signs in Spokane, Wash.

Mr. M. C. Osborn, contract agent of the Washington Water-Power Company, of Spokane, Wash., exhibited to his friends at the recent National Electric Light convention a book of photographs showing the numerous handsome electric signs on the streets of Spokane. One feature shown, which in his opinion is capable of considerable development in the down-town districts of the larger cities, is an electric sign on the corner of each building. Merchants having buildings on corners will find that an electric sign giving the name of each street, placed on the corner of the building, will not only be appre-

ciated by the public, but will help impress the location of the store on visitors in the town and bring them back to that corner to make purchases. It is thus not only a good movement from a civic standpoint, but good business for the merchants and commercial houses which put these signs up.

Central-Station Facts and Factors.

In the *Electrical World* of April 29, 1909, page 1032, a table was printed giving central-station facts and factors from seven central stations. In the issue of May 6, 1909, was another table giving similar data compiled from the reports of 26 Iowa central stations by Mr. Austin Burt, chairman of the "Fact and Factors" Committee of the Iowa Electrical Association and reported at the Cedar Rapids convention of that association April 21. Accompanying this article is a continuation of the table published in our issue of April 29, which gives data from eight more central stations. For obvious reasons, the names of companies are not published. An explanation of the various items which make up this table and the reasons for their adoption were given in connection with the first article, April 29.

TABLE OF CENTRAL-STATION FACTS AND FACTORS—II.*

	8	9	10	11	12	13	*f* 14	15
A.—General Information.								
Number of company								
Kw rating of stations	400	100	3,200	1,000	835	565	200	260
Total population of district served	5,000	1,500	85,000	15,000	15,000	7,500	3,500	5,000
B.—Utilization of Investment and Apparatus.								
Total liabilities per kw of station rating	$250	$300	....	$380	$329	$171.70	$200	....
Gross yearly income per kw of station rating	*a* $67.50 *b* $82.50	$90	$99	$89.32	$124.42	$96.48	$93.48	$88.40
Gross yearly income per $100 liabilities	*a* $27.00 *b* $33.00	$33	....	$23.50	$34.98	$56.20	$46.73	$36.00
Per cent of gross yearly income spent for operation (including everything but interest and depreciation)	....	....	54%	50%	51%	46%	56%	....
Yearly operating expenses per $100 liabilities	....	....	....	$11.90	$17.71	$26.23	$27.07	....
Average income per consumer	....	....	$97	$58.27	$78.07	$66.88	$41.91	....
Total connected load in kw per kw of station capacity	....	....	2.8	1.56	1.45	1.65	1.23	....
Connected kw-load in lamps per kw of station capacity	....	....	1.6	1.05	0.99	1.42	1.23	....
Connected per kw-load in motors per kw of station capacity	....	....	1.1	0.51	0.46	0.23	...	0.28
Connected kw-load in heating apparatus per kw of station capacity	0.67	....	0.1	...	...	...	...	....
Kw-hours sold or accounted for per 100 kw-hours generated	....	....	*c* 0.85 *d* 0.80	76.7	75.4	*e* 75	81.1	....
Kw-transformer capacity per kw of a. c. station capacity	....	....	....	*e* 0.82	*e* 0.78	*e* 0.85	0.88	....
Kw-transformer capacity per kw of connected load	....	....	....	*e* 0.78	*e* 1.01	*e* 0.61	0.77	....
Kw-station capacity per employee, all departments	....	....	....	50	59	56	40	32.5
Yearly load factor (average load divided by maximum)	17%	....	24%	22%	28%	24%	33	....
C.—Development of Territory Served.								
Gross yearly income per capita of population	*a* $5.40 *b* $6.60	$6	$3.80	$5.95	$6.92	$7.27	$5.34	$4.60
Investment per capita	$20	....	....	$25.33	$18.33	$12.93	$11.43	....
Watts station capacity per capita	80	66	41	67	56	75	57	52
Number of consumers per 100 of population	....	....	4	7	6	11	12	....

*Table I was presented in the *Electrical World* of April 29, 1909, on page 1032. *a.* Electric revenue only. *b.* Electric plus heating revenue. *c* On direct-current system. *d.* On alternating-current distribution. *e.* Lighting transformers only. *f.* No day service.

In the accompanying table, Company 8 operates an electric-light and steam-heating plant. Figures are given on the earnings, both with and without steam heat revenue. Companies 11 to 14 are located in various Western towns, all being west of central Nebraska. They are under efficient management and show the usual high earnings of Western plants properly managed.

Boiler and Engine-Room Routine in Small Central Stations.

In the smallest central stations with only one boiler and engine unit there is left no choice to the operator as to what the daily routine in the shape of starting and stopping different units shall be. However, as soon as a plant has two or three engines and boilers the question comes up of the best handling of these for different loads.

Beginning with the boiler-room, the practice of small companies differs considerably as to the cutting in and out of boilers according to load. For example, if we take the case of a small plant in which two boiler units will carry the peak load, one boiler is sometimes shut down except during the peak, being completely cut off when the fire is banked. Another method of handling is to leave the boiler cut in on the steam line, but to bank its fires. This, of course, keeps the boiler under pressure and reduces somewhat the time which would be necessary to put it in service when needed. The third method is to keep both boilers in service during the 24 hours, running them at very light load most of the time. Very conflicting testimony can be found among small central-station operators as to the relative merits of these methods. Some claim that it is just as economical to maintain in operation more boilers than are necessary to carry the load during light-load periods, as it is to reduce the number of boilers to just the capacity which will carry the load. The practice and experience of the larger central stations indicate, on the other hand, that the best results are to be expected when boilers are worked at nearly full load unless there are some very abnormal conditions in the plant. To illustrate this point, some fairly large central stations make it a practice to watch the cutting in and out of boilers closely, and to require that the feed-water consumption shall be at a rate in excess of the normal rating of the boilers in service before additional boilers can be cut in.

The reason for the higher boiler efficiency when furnaces are worked at nearly the full load of the boilers is that fires are usually under such conditions worked in such a way as to secure the better combustion of the coal burned; and in order to maintain steam the fireman is obliged, without realizing it, to keep his fires in good condition and avoid allowing an excess of air to pass in the furnace, which excess seriously affects economy. Indeed, the very fact that the fireman must manage his fires so as to get the most out of a boiler when the boiler is fully loaded, of itself helps economy. If there is an excess of boiler capacity, the boilers may be handled in a very inefficient manner and still produce steam enough to keep the plant going.

Coming to the engine-room, the routine of starting and stopping different units is necessarily dependent on the number and size of the units in the station. There is a general tendency among the smaller central stations both to purchase units much too large for the loads to be carried, and to operate large units on light loads when smaller units would give much better economy. A large unit running much underloaded many hours a day is sure to be uneconomical and to take much more steam than would be required by a smaller unit in good condition. It is a common mistake among the smaller central stations when enlarging their plant to displace small units with large ones, leaving no small units to carry the light load. The most economical stations are those which have units of such a size

that the generating equipment can be fairly well adjusted to the load to be carried at different hours of the day. It costs more per kilowatt to install small than large units, and the full-load efficiency of the former is not as good as that of large units; but it is only a few hours per day that the full-load economy of a plant is of value. Another advantage of subdividing the generating equipment of a plant is that there is less danger of interruption to the service by necessary repairs to one of the units.

The usual tendency of station operating engineers is to run units underloaded for the reason that the engines require less attention in this way. Frequently the smaller units in a plant, which are the ones which should rightly be run during light loads, are those which have been in use the greatest number of years. Consequently they are worn and not in the best of condition for economical or reliable operation. The result is that the newer larger units are run underloaded instead of the small units being operated. In such cases, of course, the thing to do is to put the small units in good condition. The general tendency not to run engines fully loaded was well illustrated a few years ago by a medium-sized plant where the plan was adopted of giving the engineers and firemen a premium for the reduction of kw-hour cost below a certain established figure. The plan worked well and a considerable premium was earned by the operating force, due to watchfulness and to station economy. One of the points which the force found by experience had a most important influence was the operation of engines well loaded, and as soon as the load fell off so that larger engines were no longer needed they were immediately shut down.

Meter Committee's Exhibit at N. E. L. A. Convention.

The exhibit made by the meter committee of the N. E. L. A. at the Atlantic City convention was the first of its kind ever given. Supplementing the voluminous report on meters made by the committee, its purpose was to bring central-station managers to a realization of the importance of meter work, and the necessity of having a well-organized meter department. To accomplish this, the most modern apparatus and equipment manufactured and the best standards obtainable were shown, and practical and technical men versed in meter practice and meter problems demonstrated the use of the apparatus and explained the theory of the various meters and devices. The exhibit contained all recent types of all makes of electrolytic, mercury commutator and induction motors for single-phase and multiphase alternating-current and direct-current circuits, in addition to special meters, such as the Wright demand meter. Representative meter installations with various types of service boxes, protective devices, etc., were set up for demonstration purposes. The testing equipment shown comprised stop-watches, standard portable indicating instruments, rotating standards, standardized resistances, portable load boxes, carbon and water rheostats, portable storage cells, test racks, special testing sets; together with tools, carrying cases, tool belts and special devices for facilitating the work of meter men. In addition to the above, suitable laboratory apparatus was shown. In this collection were recent types of primary and secondary laboratory instruments, including precision instruments, portable instruments, standard cells, standard resistances and potentiometer with accessories, experimental apparatus for demonstrating the principles of meters, an oscillograph for showing the potential and current wave forms, a binocular microscope for the inspection of jewels and pivots, power-factor meters, etc. Copies of patent specifications for meters, all books published on meters, samples of printed forms for meter departments, photographs, outlines of systems for testing meters and laboratory work were also available for the perusal of interested parties. Along one side of the exhibit space were installations typical of the present meter practice of the New York Edison Company, United Electric Light & Power Company, Philadelphia Electric Company and the Rochester Railway & Light Company. The installation and service cut-outs included all forms of devices for protecting the service and meters until the lines reach the consumers' house switch or cut-out, thus making the installations tamper-proof. Different types of lead, porcelain and metal seals for sealing cut-out boxes, service boxes, etc., were shown. These seals and sealing devices were collected from manufacturers throughout the country, and descriptions, photographs, etc., gave complete information concerning the methods of sealing. Test racks were connected to the service and arrangements for demonstrating the methods of testing in all of the 25 or 30 assorted types of meters in the exhibit were furnished in the center of the exhibition space. The meters were mounted on test racks to demonstrate the methods of testing with portable instruments, rotating standards, standardized resistances and other testing equipment. A number of meter installations were also connected to the direct-current and alternating-current service for demonstrating the methods of testing the meters when in actual service. The meters mounted on the test racks were connected in various ways, and various coils and parts were open-circuited and short-circuited to show the effect on the meter accuracy of possible troubles which may develop in service.

FIG. I.—METER EXHIBIT.

FIG. 2.—METER EXHIBIT.

The exhibit was the most interesting feature of the convention, and indicated how thoroughly the meter committee had entered into its work. Only those who were in attendance at the convention and visited the exhibit can appreciate the monumental task involved in the collection of all the apparatus on exhibition, and the thought and care displayed even to the smallest details, so that nothing would be lacking in making the meter exhibit complete and representative of the very latest practice.

Valuation of Public Utility Properties.

An interesting paper by Mr. H. C. Abell, chief engineer of the American Light & Traction Company, printed in the *Armour Engineer*, contains a discussion of several of the difficult problems which public utility commissions are now endeavoring to solve, namely, the total value of a property, proper rates of return on this valuation, equitable rates for consumers, and the London sliding scale.

The total valuation of such properties is considered to be made up of two factors, physical values and so-called intangible values. As to the former, engineers can estimate, at prevailing prices, what it costs to replace a certain piece of apparatus, or a collection of pieces concentrated on one portion of ground or under one roof, which may be called the plant or power house, but they cannot, with the same accuracy, estimate the following factors:

a. The average price paid since the utility first commenced serving the public, including the increased cost of new apparatus installed when just developed, over the later prices after the apparatus becomes standard and patents have expired.

b. The cost of necessary changes, due to the ill fitting together of these parts.

c. The changes in the art during construction, necessitating changes in plans and construction.

d. The increased cost, due to climatic or labor conditions.

e. The kind of soil and quantity of water to be encountered in all excavations.

f. The cost of accidents, employers' liability, public liability, fire, wind, water, etc., breakage of machinery, temporary work, such as coffer dams being washed out during construction, and various other items.

g. The increased cost of construction during operation, due to idle labor waiting for an opportunity to work, and to temporary work installed (in order to avoid interruptions to service) which is removed after permanent work is finished.

h. The increased operating expenses, which are unavoidable due to construction work going on.

i. The length of time necessary to construct a plant, which would affect interest while building, taxes during construction, engineering, etc.

j. The cost of obtaining all the actual necessary money to build the plant, and to put it on a self-sustaining basis.

k. The unforeseen litigation, injunctions, etc., which frequently increase enormously the original estimated cost.

l. The cost of the corporate organization of the company.

m. What the actual cost will be over the estimated cost, due to increased cost of material and labor since estimates were made, and to omissions, etc.

n. The necessity of laying out works, purchasing property, erecting buildings, etc., in order to provide for future extensions at a minimum cost for the future.

o. The present value of the plant, after depreciating the various items to allow for obsolescence, inadequacy and decay, and the enhanced value, which will be considered under intangible valuation.

As to intangible valuation, it is held by the author to be also impossible for engineers to estimate with accuracy the intangible valuation, which involves a consideration of

a. The expense of obtaining a proper and efficient operating organization.

b. The expense of maintaining an operating organization to develop business and to popularize the utility and the use of its product during the construction period, so that the plant can commence operating with the greatest possible revenue.

c. The cost of advertising—including newspapers, posters, periodicals, personal solicitation and practical demonstrations of various kinds.

d. The cost of appliances which are given away, or loss on their sale which includes free installation.

e. The loss due to operation until the utility is on a paying basis.

f. The loss in interest and profits on the investment, from the first operating period to a time when expenses and interest are earned.

g. The enhanced value of the utility due to the increased value of its real estate, location of plant, accessibility of water, railroad facilities and sewerage, location of pipes, conduits, etc., in the streets, the latter costing much less for installation, special fittings, moving of manholes, etc., when no obstructions are met, to the extent that these items are not given full consideration in making the physical valuation.

h. The enhanced or decreased value due to the utility while operating having assisted and participated in the loss or development of the town or city. The utility having been an active participator in the development of the city, must be entitled to at least the same recognition as any active merchant or banker, whose business, as a going concern, is worth something; and the utility is entitled to even more consideration, since it cannot pick up its pipes, conduits, and plant and move to another city. The inactive land owner is much better off than the utility in that although he takes the same chances in the development of the city, he takes no other chances and assumes no responsibility; whereas, the utility has actively assisted in all developments, taking the many chances of loss to which only a utility is heir, including the risks involved in the work of construction, development, and financiering.

i. The loss in the chance of apparatus, due to obsolescence or inadequacy, which could not be charged as an operating expense and still maintain rates which would hold the customers and permit the financing of the company for necessary changes and extensions. One of the many examples was the changing of monocyclic generators which had been installed but a short time. As an example, the difference between the purchase price and the price obtained after abandonment (a change having been essential), may amount to a depreciation of 40 per cent per annum. The utility company could not possibly maintain its rate and finance this change due to evolution and development, no more than could a manufacturing concern which may experience the same rapid change in the art as utility companies, if it were not permitted to add a charge for the cost of experiment and development to the sale price of its commodity. In the case of the utility, it is the development of the art for more efficient and reliable service in competition with other sources of supplying heat, light, etc.

j. The expenditures in replacing the appliances free of cost to the consumers, due to a change in the art. An example would be a change of motors from direct to alternating, from one cycle to another, or that of operating voltage, necessitating the change of all lamps and appliances. All utility companies have experienced this expense, though it does not show in a replacement inventory.

The tentative method, now used by one of the commissions to arrive at reproduction and present physical values, is as follows:

Reproduction Value.—Five-year averages are obtained from the various units which go to make up a whole; then the freight, estimated cost of installation and handling are added. To the sum of these items, which are supposed to make a completed whole, is added a percentage for engineering, interest while building, and incidentals. To the above two items is added the stock (coal, appliances, etc., on hand), and to this, the cost of paving, making a grand total for replacement.

Present Value.—The present value is arrived at as follows: By consultation, discussion, and investigation, a tentative life of each unit is taken; then the junk value is ascertained from values of old copper, iron, etc.; by deducting the junk value from the reproduction value, the depreciating value of the unit is obtained. The present value, if in first-class operating condition, is obtained by taking the age of the unit and deducting the amount which would have accumulated in a reserve fund had an amount been set aside each year, bearing a certain per cent interest, which would, at the end of its life, have equaled the total depreciating value; its junk value is then added. If in fair operating condition, 10 per cent is deducted from the

present depreciating value and, if operating, but in poor condition, 20 per cent is deducted from its present depreciating value; to either of the above values would be added the junk value.

To illustrate this method of arriving at present values, assume that the reserve fund is to be set aside at 4 per cent compound interest; that the cost of the unit is $1,200 new; that the tentative average life is 20 years; and that the junk value is $200, and that we wish to determine the value at the end of 10 years—first, when in first-class condition; second, when in fair condition; and third, when operating but in poor condition. Deducting $200 junk value leaves $1,000 as the cost of the depreciable portion of the unit new. The amount to be set aside each year at 4 per cent, compound interest, to equal $1,000 at the end of 20 years, would be $33.58. The amount set aside each year for 10 years, together with its accumulated interest, would be $403.

Deducting $403 from $1,000 leaves $597, to which must be added the junk value, $200, making a present value of the unit, if in good operating condition, of $797; if in fair operating condition, 10 per cent is deducted from $597, making the total present value $737.30; if operating but in poor condition, 20 per cent is deducted from $597, making the present value $677.60.

Minimum service values are allowed for the various units which, from point of age, might make the value of the unit equivalent to junk only, though it would be in useful operation. For instance, electric meters, which are subject to state or municipal inspection, or both, and have to be kept in a certain state of repair at all times, are allowed a minimum service value of 80 per cent of the reproduction cost; whereas, with a steam engine that has been in service a number of years but which may be in a good state of repair though not having the same efficiency as a more modern engine, or sufficiently good to be put in a newly built plant, only 25 per cent of its reproduction value is allowed.

There is a great diversity of opinion among engineers as to the approximate correctness of the above method of arriving at present value. Some engineers claim that each unit should be gone over, first obtaining its reproduction value, and then depreciating it in proportion to the cost of making the unit practically new. Other engineers think that in addition to the above, a further amount should be deducted for depreciation in proportion to the change in the art. Still others think that the present value of a plant should be estimated on a basis relative to most modern apparatus.

As an example: Suppose it is the desire to obtain the value of a water-power plant of 1000 kw capacity, with a load factor of 40 per cent. A figure would first be obtained for the most economical steam plant of this capacity, which, for illustrative purposes, we will assume to cost $100,000. Further assuming that the cost per kw-hour is 1 cent, not including interest, and that the water-power plant can develop current at 0.5 cent per kw-hour on the same basis as that taken for steam, then the saving per kw-hour, by using the water-power plant, would be 0.5 cent, or on a 40 per cent load factor (3,504,000 kw-hours per year), the saving would be $17,530. This sum capitalized at 10 per cent (the allowable rate of return on the investment) would make the value of the water power $175,200 more than that of the steam, or give the water power a total value of $275,000. The depreciation is assumed to be included in the operating expenses.

As to depreciation and the amount to be set aside therefor, the line of demarcation between depreciation and maintenance is difficult to follow. Some engineers and managers think that maintenance and depreciation should all be an operating expense, as it is essential to keep a plant up to a certain point of repair at all times. They think when a piece of apparatus is replaced, the difference between the amount received for it, either as junk or an old piece of apparatus, and the cost of the apparatus replacing it, should be charged to plant account. Others think the difference between the actual cost of the old apparatus and the new should be charged to the plant account, and that the cost of the old apparatus should be charged off to an operating maintenance account. They also think that the utility enhances in value as the city develops in a larger proportion than the depreciation occurs.

Others think that an amount should be set aside each year sufficient to cover the depreciation according to assumed lives. For instance, to take the example of $1,200 previously mentioned, $50 would be set aside each year for 20 years, if the apparatus should last that long. There are also various opinions as to how the fund should be treated and financed.

The commission previously referred to when obtaining present values, used a 4 per cent compound interest curve, knowing that the apparatus had actually reached its present life. As to the future, however, it is difficult to prognosticate what these lives will be; in fact, we are certain that a portion of the plant will not reach the estimated lives of its several parts, and that a portion may be in useful operation long after it has from point of age reached the junk value. Mr. Abell believes that an amount should be allowed that would cover the probable depreciation without reference to any specific financing of the fund, and the amount be changed, either reduced or increased, as necessity requires and actual experience teaches. If in every case an amount be set aside each year to cover the probable depreciation, some properties would soon be in the hands of a receiver, as they would be unable to meet necessary obligations. Commissions will have to use their judgments in this matter.

INTERIOR WIRING AND ILLUMINATION

Street Series Tungsten Lamps Burned at an Angle.

By George T. Hanchett.

There is probably no field where the tungsten lamp has a better opportunity to give satisfaction than in street series lighting service, for the circuit may be so designed that the voltage on the lamps can be chosen without reference to the existing source of supply. A recent experience of the writer's may be of some interest in this connection.

In the instance in question, 250 carbon lamps of 3 amp at 25 volts were replaced by an equal number of tungsten lamps taking 5½ amp at 6 volts. The lamps were installed in fixtures which supported them at an angle of about 45 deg., and it was

TUNGSTEN LAMP BURNED AT AN ANGLE.

believed that the short, stumpy filament was abundantly strong to withstand the vibration and retain its position within the bulb. The sockets employed were the usual spring-clip, paper cut-out, weather-proof receptacle, with a large screw base, while the bulb of the lamp was very large, about the size of the 100-watt, 110-volt standard tungsten bulb.

As soon as the lamp had been installed it was immediately noted that the filaments began to droop, as shown in the diagram, which was somewhat disconcerting, for it indicated that there would soon be a considerable percentage of loss. The droop was anxiously watched and it presently seemed to attain a permanent condition, the filament hanging in a little catenary between the two leading-in wires. The expected failures did not come. The lamps seemed to be entirely satisfied with the

new conditions and continued to give good service; in short, they automatically adjusted themselves to a 45 deg. angle. As the filament is too short to touch the sides of the glass under this condition, there seems to be no further cause for apprehension.

It would seem to me a wise measure of precaution, however, in view of this experience, to direct the linemen who have to care for the lamps to install all street series lamps burned at an angle in such a way that a line drawn through the tips of the leading-in wires will be as nearly horizontal as possible; and that if it be found that the pitch of the filament with relation to the threads on the sockets is such that the position of the leading-in wires can only be vertical, to select another lamp for that particular socket and use the troublesome lamp elsewhere.

Experience seems to show that a considerable angle from the horizontal with respect to the filament plane is permissible; in short, any angle in which the droop, when it occurs, shall be such that there shall be no short-circuiting.

It is hardly necessary to say that in case the lamp should be removed for any purpose after it has once drooped, and reinstalled, care must be taken that it be restored to the exact position in which it was found; for it is obvious that if the filament has to droop to a new position its chances of failure are considerably enhanced.

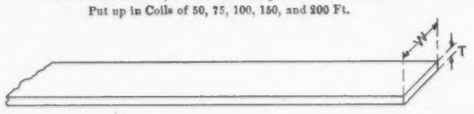
The Use of Fish Wire in Conduit Work.

By Arthur Gillman.

Assuming the wrought-iron conduit in a wiring installation in place, the operations toward the completion of the wiring may be given in the order of their performance, as follows:

(1) "Fishing" the conduit. (2) Fastening the fishing wire to the electrical conductors to be drawn into the conduit, if conditions will admit of their being drawn in thereby, or to a pulling-in line if such is necessary. (3) Drawing the pulling-in line into the conduit with the fishing line (if a pulling-in line is necessary) and fastening the pulling-in line to the conductors to be drawn in. (4) Drawing the conductors into the conduit with the fishing wire, if this is feasible, or with a pulling-in line. The first two operations will be discussed at length in the present article and the methods employed for their performance described.

OIL TEMPERED, FLAT STEEL, FISHING WIRE
Put up in Coils of 50, 75, 100, 150, and 200 Ft.



W WIDTH INCHES	T THICKNESS INCHES	WEIGHT PER 100 FEET	APPROXIMATE PRICE CENTS	
			PER POUND	PER FOOT
1/8	.015	11oz.	90.0	.62
1/8	.030	1lb. 4oz.	60.0	.75
3/16	.030	1lb. 14oz.	60.0	1.13
1/4	.030	2lb. 8oz.	60.0	1.50
5/16	.035	3lb. 8oz.	55.0	1.93
3/8	.035	3lb. 12oz.	55.0	2.06

FIG. 1.—PROPERTIES OF STEEL FISHING WIRE.

FISHING THE CONDUIT.

"Fishing" (a term analogous to "rodding," which is used in connection with underground conduit work) consists of pushing through the conduit a stiff wire to which can be fastened and thereby drawn through the conduit another line (either a pulling-in line or a copper conductor), which by reason of its flexibility could not itself be pushed through. A tempered, flat-steel ribbon wire is generally used for the purpose. In the table (Fig. 1) are given the principal properties and costs of the wires most frequently used for fishing. The prices will vary with the quantity purchased. Those noted are a fair average for small lots. The 1/8-in. wide by 0.030-in. thick size is used much more generally than any of the others and many electrical supply houses stock only this size, which will

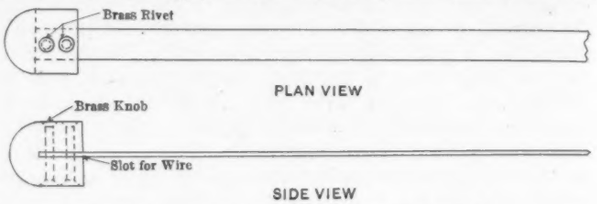
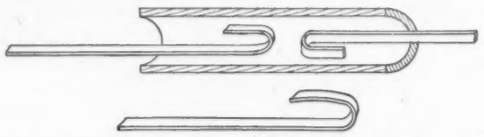


FIG. 2.—KNOB ON END OF FISHING WIRE.

be found to satisfy all the requirements necessary to interior conduit fishing.

So that the wire will slide easily through the conduit, past the joints between lengths and around the elbows, a metallic knob, preferably of brass to prevent rusting, is frequently riveted to one of its ends, as shown in Fig. 2. The best dimensions for the knob depend upon the size of conduit in which it is to be used. It must not be of too great diameter or too long or it will bind in the elbows. If much fishing is to be done, the cost of providing knobs on the ends of fish lines will be a good investment.

Where knobs cannot be arranged for in lieu of such the end of a fishing wire, which is to be pushed into the conduit, can be



FIGS. 3 AND 4.—HOOK ON FISH WIRE AND METHOD OF FISHING FROM BOTH ENDS.

bent into a hook, as shown in Fig. 3. This makeshift will give good service. Hundreds of feet of conduit have been fished with wire thus prepared. If it is impossible to push fishing wire from one outlet to the next, due to some binding or obstruction within the conduit, often two fishing wires are fed into the conduit, one from each end, each having a hook formed on its extremity, as shown in Fig. 4. The hooks will engage and one fishing wire can be pulled through the conduit by the other.

Patience is required to effect such an engagement. Two men are required, one at the outer end of each fishing wire. Each must push in for a foot or so and then slightly withdraw his wire. This is repeated until, by the sound, it is apparent that the two hooked ends are close together. Then it is a matter of trial and luck; but persistence is always rewarded. If it happens that a run to be fished is longer than any available fishing wire, two wires can be used, one fed in from either end and hooked together within the conduit as above described. Then, a pulling-in line, or the conductors to be drawn in, if they are small, can be secured to the outer end of one fishing wire and the whole pulled into the conduit by the other.

No. 10 or 12 B. W. G. galvanized-steel wire has been used quite successfully for fishing, particularly through larger-size conduit, say, 1 in. and over. It has the advantage of being readily obtained and of cheapness, and a further advantage that it can also be used for a pulling-in line. This point will be taken up in detail later. Galvanized-steel wire, which is more commonly, though incorrectly, called galvanized-iron wire, is regularly carried by most hardware stores and is used for wire fences, baling, etc. To prepare such a wire for fishing, it is only necessary to hook over one end after the manner shown in Fig. 3.

FASTENING THE FISH WIRE.

If a steel-ribbon wire has been used for fishing a conduit, electrical conductors, if they are small, say, No. 12 or 14

B. & S. gage, can be attached to one end of it in the manner indicated in Fig. 5. A loop is formed in the end of the fishing line and copper wire sewed around the end of the loop. This sewing should be soldered for best results. The bared conductors are "made up" into the loop and the whole sewed with friction tape, as shown in Fig. 6. The tape sewing should taper regularly from the size of the fishing wire to that of the two conductors, so that the joint will slide easily into the conduit and past irregularities therein without seizing. If the conduit into which wires are to be pulled is small in proportion to the

FIG. 5.—ATTACHMENT OF CONDUCTORS TO FISH WIRE.

over-all size of the pair of wires, it is advisable to compress the loop in the fishing wire, making it flatter than shown in Fig. 5. One bared conductor is "made up" into this flattened loop. The other bared conductor is sewed around its bared mate from which the insulation has been trimmed for a distance of about 3 in. This method provides a long, tapering attachment which, if carefully sewed with tape, will draw into any conduit sufficiently large to receive the wires. The illustration and description treat of but two wires. If there are three, the

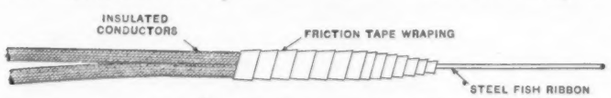


FIG. 6.—CONNECTION TAPED OVER.

general methods are the same and if not understood from the above they will be apparent upon trial.

It is not wise to pull wires larger than No. 12 or 14 into conduit with a steel-ribbon fishing wire unless conditions are such that the wires pull into the conduit very easily, which might be the case in a short run without elbows or if the wires were very flexible or small in relation to the size of the conduit.

If heavy wires are pulled in with a ribbon fishing wire there is a possibility of straining the fishing wire beyond its elastic

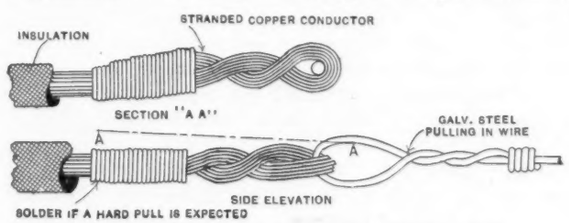


FIG. 7.—CONDUCTOR FASTENED TO FISHING WIRE.

limit, and, as the wiremen say, "it loses its life." That is, it loses its original tendency to assume the form of a long, straight ribbon and tends to roll into twists and curls. This makes it very difficult to push into a conduit, and for rapid, serious work almost worthless. A steel-ribbon fishing wire severely stressed by being used as a pulling-in line is also apt to become brittle and to break when partially pushed in a conduit. If a round galvanized-steel wire has been used for fishing, rather large conductors can be pulled in with it. There is

FIG. 8.—ATTACHMENT OF RIBBON WIRE TO ROPE.

not the danger with this as with steel-ribbon wire of straining it unduly because of the greater cross-section of the galvanized wire, and even if it is so stretched as to render it useless as a fishing wire it can be discarded with little loss.

Fig. 7 shows one method of attaching a stranded conductor to a galvanized-steel pulling-in wire. The engraving is self-explanatory. If two conductors are to be pulled in one of them is "made up" into a loop in the end of the pulling-in wire, as shown in Fig. 7. The insulating covering is trimmed from this conductor and the bared end of the other conductor of the pair is "made up" about the first one, forming a long tapering connection. If a hard pull is expected it is advisable to solder the connection. The whole should then be served with tape as shown in Fig. 6. If three wires are to be drawn in instead of two, the process is the same with the addition that the bared end of the third conductor is made up around the other two. The points to be watched in connecting conductors to a pulling-in wire or line are that the diameter at any section of the con-

FIG. 9.—ATTACHMENT TAPED OVER.

nection shall not exceed the over-all diameter of the wires connected and that the connection shall gradually taper from the size of the pulling-in wire or line to the over-all size of the wires to be pulled in. If these points are observed the connection will form a conical wedge. Sometimes to meet the conditions outlined above it is necessary to cut off possibly half of the strands from the bared end of the conductor and "make up" the connection from the strands that remain.

If conduit has been fished with a steel-ribbon fishing wire and conductors larger than No. 12 are to be drawn in, it is best to pull in a drawing-in line with the fishing wire rather than to attempt to pull in the conductors with the fishing wire for the reason already mentioned. If a rope is to be used for a pulling-in line a ribbon fishing wire can be attached to it, as shown in Fig. 8. A slit is cut in the rope, the end of the ribbon wire passed through it and then bound down with a copper wire, serving as shown. Tape should be applied also, the joint looking like that shown in Fig. 9 when finished.

Galvanized-steel wire (No. 10 or 12, B. W. G.) makes an excellent pulling-in line. It is better than rope for heavy work.

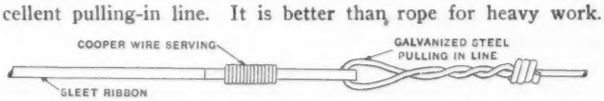


FIG. 10.—ATTACHMENT OF RIBBON WIRE TO GALVANIZED STEEL.

Fig. 10 indicates how an attachment should be made to this material. For very heavy pulls two or more strands of galvanized wire should be used. Fig. 11 illustrates how an attachment should be made where two strands of galvanized wire are to be used for a pulling-in line. Braided rope is usually used for pulling-in line, although, as above suggested, it is believed that galvanized-steel wire is better. Twisted manila rope is sometimes utilized, but it tends to untwist when subjected to stress and in doing so twists the conductors within the conduit causing them to pull hard around the elbows. Braided rope, or as it is called by the trade, "cord," is manufactured in a variety of diameters from 7/36 in. up to ½ in. The smaller sizes are frequently used for sash cords, bell ropes and arc-lamp cords. Comparing cord with galvanized-steel wire as a pulling-in line material, it is very much more bulky for the same strength, is more expensive, wears out much more quickly under severe usage and it is difficult to tie it to the hook of a set of tackle blocks with a knot that will not cut and

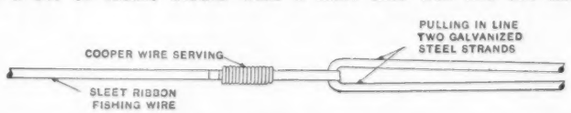


FIG. 11.—ATTACHMENT OF RIBBON WIRE TO TWO GALVANIZED STRANDS.

thus sever the cord. Furthermore, it does not appear to be possible to buy a cord sufficiently strong to pull in very heavy runs. The latter respond nicely to several strands of galvanized-steel wire. Galvanized-steel wire can be very quickly and positively secured to a tackle block hook through the agency of a wire grip similar to that shown in Fig. 12. Steel hoisting cable, such as that used on cranes, has been tried, but

because of its high cost and tendency to cut when tied to a tackle-block hook, has not been found satisfactory. Methods

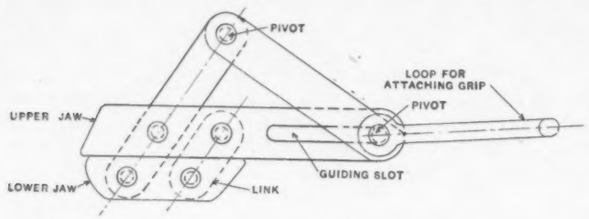


FIG. 12.—PARALLEL JAW WIRE GRIP.

of drawing conductors into the conduit will be described in a subsequent article.

New Telephone Patents.

NEW CIRCUITS.

With the earlier multiple switchboards the busy-test contact and one of the line contacts were the same. This introduced so many chances for trouble and false test that when the first branch terminal and common-battery systems were developed busy-test circuits were planned entirely isolated from the line circuits. This overcame the former difficulties to so great an extent that when the two-wire common-battery system was put forth it was necessary to take many precautions and to provide many special means to keep from falling back into the difficulties of the earlier day. These various special means have resulted in numerous patents, two of which have recently been issued to Mr. H. G. Webster, of Chicago, Ill., and assigned by him to Mr. M. G. Kellogg.

One of these provides an arrangement of cord circuits such that only when the listening key is thrown is the tip of the testing or calling cord connected to the busy-test circuit. At this time it is cleared from the line circuit entirely and is led through one of the relays individual to the cord circuit, thence through the special contacts of the listening key and thence through a high non-inductive resistance to a busy-test relay common to the position. This latter, through its contacts, controls the busy-test signal associated with the operator's head telephone. It will be seen that when two listening keys are thrown at once, one connected to a circuit in use and the other connected in the circuit used for testing, were it not for the resistance inserted between the listening key contacts and the busy-test relay, there might be a tendency to a cross effect between the two cord circuits. The high resistance, however, is inserted to prevent any such action. Of course, in the act of testing, provided there is a battery on the test ring of the line tested, this will flow through the circuit outlined and through the busy-test relay to ground, causing this latter to operate, thereby effecting an audible test in the operator's telephone.

Mr. Webster's second patent provides a busy-test circuit wherein, as before, the tip of the calling or testing plug is severed from the line circuit and connected to the test circuit when the listening key is thrown. In case a listening key is thrown after a connection is established it will not do for the tip strand to be severed. Because of this, an auxiliary relay is introduced which operates provided the calling plug is connected to a line the receiver of one of the stations of which is off the hook. This auxiliary relay, through its contacts, so shunts out the auxiliary listening-key contacts that the tip strand is not severed.

Three other patents have been recently granted to Mr. Webster for adaptations of what may be termed "two-stage" or "double-acting relays." These patents are also assigned to Mr. Kellogg.

The first one relates to a two-wire common-battery switchboard system, in which a single relay serves the purposes of both line cut-off relays. The removal of a receiver from the hook energizes the relay sufficiently to cause it to move through the first stage, thereby closing the circuit of the line lamp. The insertion of a plug in the jack through a secondary winding energizes the relay sufficiently to cause the second operation to take place, thereby performing all the functions of a cut-off relay.

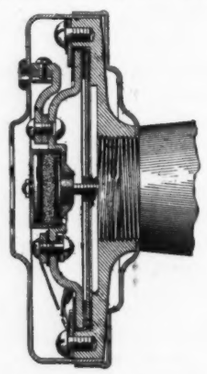
The two other adaptations are to a system of signaling, wherein an automatic dial device is associated with the telephone line, this device being arranged to send in to a common recorder code signals of the messenger-call type. It will be seen that if any one of the numerous branch lines of such a system becomes grounded the whole system will be deranged. By means of the two-stage relay, associated with a slow-acting relay, Mr. Webster has arranged a system by means of which not only will the normal signals be received, the relay operating through its first stage only in response to each current impulse, but also, when a sufficiently prolonged current exists due to a defect, and the slow-acting relay has, therefore, time to act, the auxiliary winding will be brought into play. This results in the two-stage relay completing its operation through its second stage, permanently severing and locking the defective branch out of service.

The second patent for this class of circuit dispenses with the slow-acting relay, combining all the functions in the double-acting relay by means of an unbalancing effect of two differential coils.

TRANSMITTERS.

The cut below shows a transmitter, the patent of Mr. H. F. Albright, of New York City; the patent is assigned to the Western Electric Company. The transmitter is founded upon a heavy front piece somewhat different from the usual one because it is not exposed to view, but is covered by a sheet-metal casing clamped on by the transmitter mouthpiece. This heavy front supports the diaphragm and also the bridge, which in this case takes the form of a pressed sheet-metal disk, saucer-shaped. This is shown in section in the cut. The microphone button is supported in a recess in the bridge, it having threads upon its periphery to engage internal threads on the walls of the receptacle. Provision is also made for rather heavy terminal plates of sheet metal secured to the bridge.

A number of years ago it was suggested that more efficiency could be obtained from a transmitter were the vibrations of its diaphragm caused by direct contact with some vibrating part of the voice mechanism, rather than by impinging sound waves. One of the suggestions at that time was a button to be attached to the diaphragm and to be pressed against the side of the throat of the user. With a similar idea, Mr. E. Koehler, of Philadelphia, Pa., has produced a transmitter, the vibrations for which are to be received from the body of the speaker. A spring shoulder clamp is provided, one arm of the clamp pass-



ALBRIGHT TRANSMITTER.

ing over the back of the user and the other over his chest, the hinge being above the shoulder. A spring forces these two arms toward each other, and from a point near the hinge a bar arises, upon the top of which the receiver is mounted. The transmitter is upon the end of the front, or chest side arm, and through the action of the spring is held tightly against the chest of the user, and thereby receives vibrations directly from the body.

LETTERS TO THE EDITORS.

Ballistic Galvanometer Constant.

To the Editors of Electrical World:

SIRS:—The printer's improvement of the punctuation in my letter on "Calibrating the Ballistic Galvanometer" in your issue of June 10 entirely spoils the statement of the way in which the "throw" or the quantity constant depends upon the "deflection" or the steady current constant of any galvanometer. The value of $1/2\pi$ is a coefficient, or factor, to the expressions following, and the semicolon does not belong there. To avoid all possibility of misunderstanding the relations, the form might be restated as follows:

Constant for quantity = constant for current × period × $(1 + \frac{1}{2}\lambda) \div 2\pi$.

One may, therefore, get the constant of a galvanometer for ballistic use by finding the current required to give a unit steady deflection, the time required for a complete oscillation of the moving parts while connected to a circuit exactly like the one used in the ballistic work, the logarithmic decrement when on the same circuit, and then inserting these values into the above expression. In this case, only standard resistances and a known e.m.f. are required to calibrate the galvanometer for ballistic use.

POTSDAM, N. Y. B. B. BRACKETT.

Self-Induction.

To the Editors of Electrical World:

SIRS:—In your issue of May 20, page 1195, I read: "Self-induction may be defined as that property of a circuit by virtue of which changes in current strength can only be brought about by electromotive forces."

In opposition to this, I should like to say that we may define self-induction as the property of an electric current in a certain circuit by which *electromotive forces are generated* when changes in current strength are being brought about. And we may add, that these electromotive forces of self-induction are always such that they tend to produce changes in the current opposed to those which produce the self-induction. This is an extension of the well-known Lenz law. Moreover, we know that these electromotive forces are due to the changes in the flux of magnetic induction corresponding to the changes in current strength. Or in other words, the electromotive forces of self-induction are nothing else than electromotive forces of electrodynamic induction, and therefore the general laws of electrodynamic induction (Faraday's and Maxwell's laws) are applicable to determine the electromotive forces of self-induction.

Though some effects of the electric current appear as if it (the electric current) had material inertia, we know, since Hertz's experiments of 1879-1881[1], confirmed by all investigations up to the present time, that the *electric current has no material inertia* and that it is *solely the electro-dynamic induction* which produces the phenomena observed.

SCHEVENINGEN, HOLLAND. C. L. R. E. MENGES.

[The question as to whether the e. m. f. of self-induction brings about the change in current, or whether the change in current brings about the e. m. f. of self-induction, verges upon metaphysics, and would form an interesting topic for debate. The question is likely, however, to be of more interest to physicists than to electrical engineers. The proposition, stated by Mr. Menges, that "the electric current has no material inertia," is also a fitting matter for debate, because it is now very generally believed that all mechanical inertia in matter may be attributable to the electromagnetic inertia of moving charges (*i. e.*, electric currents of displacement.) This question also is of much interest, but rather to physicists than to engineers for the present.—EDS.]

[1] See "Hertz gesammelte Werke," Vol. I, "Einleitung," p. XII-XIII, and the reprinted papers, p. 1 and p. 145. For an excellent review, see von Helmholz's preface to Vol. III, pp. XII-XIII.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Armature Reaction.—G. KAPP.—An illustrated note on the experimental analysis of armature reaction. The author describes two tests for separating the reactance voltage and the drop produced by armature back excitation in a polyphase armature. The machine is worked short-circuited and the excitation regulated so that the current in one phase remains the same, while the number of phases included in the circuit is varied.—Lond. *Electrician*, June 4.

Single-Phase Commutator Motors.—J. FISCHER-HINNEN.—The first part of a mathematical paper in which the author gives formulas and numerical examples for the predetermination of the dimensions and windings of single-phase commutator motors. He discusses the series motor with windings distributed over the surface, the series motor with pronounced poles without a compensation winding, means for suppressing the formation of sparks (especially the calculation of interpoles and the use of resistances in the leads to the commutator), and finally the graphical treatment of the series motor. The paper is to be concluded.—*Elek. Zeit.*, May 27 and June 3.

Lamps and Lighting.

Two-Hundred-and-Twenty-Volt Osram Lamps.—A 16-cp osram lamp for pressures between 100 and 130 volts, and a 32-cp lamp for pressures up to 260 volts, have been put on the market by the General Electric Company, of London. The former consumes 17 watts and the latter 40 watts. Results are given of tests made in the (British) National Physical Laboratory on nine 220-volt 50-cp osram lamps, which were not selected, but taken from stock. Before the life tests were commenced an initial test showed that the mean horizontal (British) candle-power varied between 43.6 and 48.2, the average being 46.6. The watts consumed averaged 65, and the watts per candle 1.4. The lamps were then tested in a pendant position at a constant pressure of 220 volts, and readings taken at intervals over a period of 2000 hours, at the end of which time five of the lamps were still burning. On the occasion of a filament breaking no attempt was made to re-fuse the limbs together; and if fusion occurred automatically, the lamp was counted as having broken. The points where the four lamps broke down are marked by arrows in the accompanying curves, Fig. 1, which shows the average results for the nine lamps.

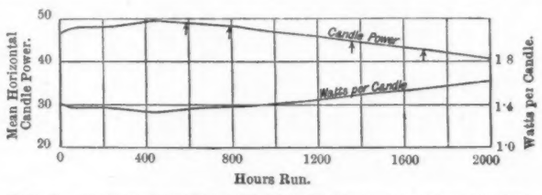


FIG. 1.—AVERAGE CURVES OF LIFE TESTS ON OSRAM LAMPS.

The behavior of the lamps was strikingly uniform. All the lamps reached a maximum candle-power (which varied between 47.5 cp and 50.5 cp) shortly after 400 hours, and the candle-power of the remaining lamps at the end of the 2000 hours' run of lamps burning at any time was 46.2 cp and the average watts per candle over the same period 1.45. It is also stated that the Allegemeine Elektricitäts-Gesellschaft, of Berlin, is already advertising in the German papers a 25-cp, 200-volt to

250-volt tungsten lamp, and the Sunbeam Lamp Company, of Gateshead, will be in a position to deliver 22-cp tungsten lamps for pressures up to 250 volts in the course of a few weeks.—Lond. *Elec. Eng'ing,* June 3.

Tungsten Lamp.—A note on a recent British patent (25,854, 1908; May 27, 1909) of the Siemens & Halske Company. Powdered tungsten is treated chemically or electrochemically so that each particle of tungsten receives a deposit of 10 to 20 per cent of a ductile metal such as silver or nickel. The product is pressed and rolled, and the mixture becomes so intimate that a ductile metal that can be drawn into filaments is obtained. The nickel or silver is removed by heating the finished filament in a vacuum. In a modification, the treated powder is first stamped into a tube of ductile metal and then drawn into fine filaments, the foreign metals being removed afterward as in the first case.—Lond. *Elec. Eng'ing,* June 3.

Tungsten Lamp.—A note on a recent British patent (14,942, 1908; May 27, 1909) of the Westinghouse Metallic Filament Lamp Company. Tungsten trioxide is reduced by means of zinc at a red heat, and the product treated with a hydrochloric and nitric acid solution to remove the excess of zinc and the zinc oxide. The product is then thoroughly washed and concentrated by evaporation. The pasty mass obtained without the addition of any binding agents is formed into filaments. These, after being heated in a muffle furnace at about 800 deg. C. for half an hour, are raised to a white heat in an atmosphere of hydrogen and nitrogen by passing a current through them.—Lond. *Elec. Eng'ing,* June 3.

Supports for Metallic Filaments.—A note on a recent British patent (23,069, 1908; May 27, 1909) of the British Thomson-Houston Company (General Electric Company of this country). In the arrangement described the lower end of the loops are welded to metal arms radiating from the base of the pedestal. A number of short copper wires fixed vertically on the top of the pedestal support horizontal pieces of nickel wire. Each nickel arm carries at its extremity a small loop of tungsten or molybdenum, through which the filament passes. The nickel wire acts as a spring holding the filament in tension, and can be joined to the supporting loop by winding the end round the crossed legs of the loop. The other end is welded to the copper support. The supporting loop and the nickel wire spring should have diameters slightly larger than the diameter of the filament.—Lond. *Elec. Eng'ing,* June 3.

Gas Versus Arc Lamps at Bradford.—An account of the results of comparative tests of gas and flame-arc street lighting in a street in Bradford. Although the distribution of light is not so uniform with the arc lamps as with the gas lamps, owing to the latter being placed close together, the average and the maximum illumination were much greater in the case of the

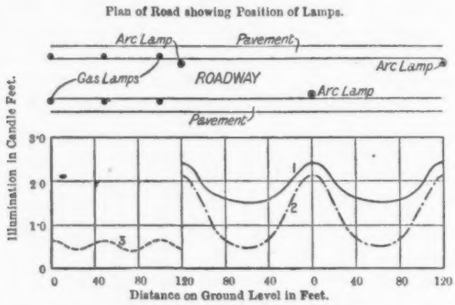


FIG. 2.—TEST CURVES OF EXPERIMENTAL GAS AND ELECTRIC STREET LIGHTING.

electric lighting, notwithstanding the fact that the cost of the electric lighting works out at 6s. 5d. per yard, as against 7s. 5¾d. per yard for gas (taking gas at 2s. 1d. per 1000 cu. ft., less 12½ per cent). Owing to reasons, however, which are not immediately apparent, gas lighting has been chosen. The results of the tests are given graphically in Fig. 2. Curve 1 refers to Excello flame-arc lamps fitted with dioptric globes, curve 2 refers to the same arc lamp fitted with ordinary globes, and curve 3 to gas lamps with three incandescent mantles. One of the possible reasons which have influenced the decision against arc lamps is thought to have been the yellow color of the flame arcs used. Further, "the general impression that the gas installation gave the better light," the writer thinks was due to the fact that the gas lanterns were so near to the road that the sources of light were very near the eyes, whereas in the case of the arc lamps they were well above the head, and only the effects of the light on the road were observed.—Lond. *Electrician,* June 4; *Elec. Eng'ing,* June 3.

Carbon Arcs.—M. Rosenmüller.—An account of an experimental investigation of the light emission and absorption of carbon arcs. The author used homogeneous carbons, 13 mm long, and consuming 13.5 amp at 68 volts. The chief emission of the arc is at 385 $\mu\mu$. Regions of strong emission are also regions of strong absorption. Such wave lengths, for which the emission is not considerable, are not absorbed in a measurable degree. This agrees with the assumption that the radiation of the arc is pure "temperature radiation." From the ratio between emission and absorption the "black-body temperature" of the arc is found to be 3800 deg C. This figure agrees with the results of other investigators.—*Elek. Zeit.,* May 27.

Ultra-Violet Rays from Lamps.—W. Voege.—An article in which the author replies to various criticisms of Schanz and Stockhausen concerning the necessity of protecting the eyes against the ultra-violet rays from artificial sources of light. On the basis of new experiments, in agreement with the opinions of oculists, he shows the incorrectness of the alleged bad effects of the ultra-violet rays of artificial lamps. The author finally discusses the use of various sorts of glass for the protection of the eyes in exceptional special cases against ultra-violet light.—*Elek. Zeit.,* June 3.

Power.

Printing Press.—An illustrated description of a large octuple rotary press, electrically driven and controlled on the Crompton-Kohler system of multiple push-button control which has recently been installed in the printing office of *The Times,* of London. The press can be controlled from 16 different points, and a very gradual start and a wide range of speed are obtained. A small motor is used for the lowest speeds, the load being transferred to a large motor when a certain speed has been attained.—Lond. *Elec. Eng'ing,* June 3.

Electric Power in Theaters.—Schallenmüller.—A paper read before the Electrical Society of Karlsruhe on the use of electricity for power purposes and lighting on the stage.—*Elek. Zeit.,* June 3.

Cranes.—H. H. Broughton.—A continuation of his long illustrated serial, the present section dealing with the mechanical equipment of cranes. The author describes the "free-barrel" system in use in nearly all the harbors and docks in England, and then deals with lifting magnets.—Lond. *Electrician,* June 4.

Cranes.—C. Michenfelder.—The first part of an illustrated article on electromagnetic cranes for loading and unloading.—*Elek. Zeit.,* June 3.

"Vacuum Turbines."—The application of steam turbines to the utilization of exhaust steam, either from condensing or non-condensing engines, is discussed in an article which also contains illustrations of machinery of this class manufactured by a British manufacturing company.—Lond. *Elec. Eng'ing,* June 3.

Exhaust Steam.—E. W. Lehmann-Richter.—An article giving examples from practice on the economies obtainable from the use of exhaust steam for heating.—*Elek. Zeit.,* May 27.

Traction.

Railway Signals.—An illustrated description of the signal and dispatching system of the Mimico division of the Toronto & York Radial Railway. This line, which is single track and carries very heavy traffic, is equipped with a system of block signals and telephone dispatching apparatus which gives a continuous record of the location of every car on the line in the dispatcher's office, displays danger signals in the motorman's cab when the dispatcher desires to communicate with the train

crew or the block ahead is occupied, and embodies telephone communicating apparatus in each car which is automatically placed in circuit with the dispatcher's line when the car arrives at reporting points.—*Elec. Railway Jour.*, June 12.

Wires, Wiring and Conduits.

Wiring Rules.—A note on a new issue of the Wiring Rules of the Phoenix Fire Office, which is thought to be the most widely adopted in England with the exception of the Wiring Rules of the Institution of Electrical Engineers. The following two rules are noticed, viz.: (1) that all joints in tubing should be treated with aluminum paint, and (2) that flexible cords not provided with an efficient flame-proof outer covering must not be used in shop windows containing inflammable goods.—Lond. *Electrician*, June 4.

Electrophysics and Magnetism.

Effect of Temperature on Hysteresis.—W. P. FULLER AND H. GRACE.—An abstract of a London Physical Society paper on the effect of temperature on the hysteresis loss in iron in a rotating field. The rotating field was produced by means of two-phase currents. One phase was connected to a coil of long rectangular section and of sufficient length to produce a uniform field within a radius of 2 cm from the center. The second phase was connected to a similar coil enclosing this one and causing a flux at right angles to it. The resultant field at the center was uniformly rotating. An iron disk, 4 cm diameter, 0.027 cm thick, was supported by a bifilar suspension and the torque measured by a mirror and scale in the usual way. The specimen was heated by means of nickel-wire heaters placed above and below it, and the temperature measured by means of a thermo-junction placed close to the disk. The flux in the iron was measured by the voltage induced in a coil of eight turns of bare wire wound round it. To measure the voltage, the maximum value of which was of the order of 0.03 root mean square volt, a special galvanometer was constructed. This depends for its action on the forces exerted by a rotating field on a suspended coil carrying alternating currents. If E be the e.m.f. applied to the moving coil, and E_1 the e.m.f. due to the field on the coil, then, by turning the coils producing the field round until the deflection is a minimum, this deflection is proportional to E-E_1. The results of the experiment show that the effect of increasing the temperature of iron is to reduce the hysteresis loss at a given induction and to cause the maximum loss to occur at a lower value of the induction. In one specimen the maximum value of the loss at 220 deg. C. was 12,300 ergs per cubic centimeter per cycle at an induction of 16,000 c.g.s. units. At 580 deg. C. the maximum loss was 2600 ergs at an induction of 10,700. The frequency in the experiments was 42 cycles per second.—Lond. *Electrician*, June 4.

Electrons.—J. H. JEANS.—The first part of a theory of the motion of electrons in solids. Former electronic theories make use of the conception of a motion consisting of free paths and collisions. The present author endeavors to develop a theory which is free from all such suppositions. In the present paper he discusses electric conductivity, Kirchhoff's law and radiation of great wave-length. One of the results of this investigation is that the author derives Kirchhoff's law as a consequence purely of the electron theory. It appears that the law is true quite independently of whether the ether is in equilibrium with matter or not—in fact, the law is seen to be entirely independent of thermodynamic conditions of all kinds. It is consequently illegitimate to draw any thermodynamical inferences from the fact that Kirchhoff's law is observed to be true in nature.—*Phil. Mag.*, June.

Thermionics.—O. W. RICHARDSON.—The term "thermionics" is applied by the author to such phenomena as the emission of ions by hot bodies, the leak from hot wires, and a number of other phrases. The ions emitted by hot bodies are called "thermions." The paper of the author is a general and highly mathematical theory of this branch of physics.—*Phil. Mag.*, June.

Electrochemistry and Batteries.

Water Purification.—H. C. H. SHENTON.—A paper read before the (British) Institution of Municipal Engineers on the practical sterilization of water and of sewage effluents. Both ozone sterilization and hypochlorite sterilization are discussed. Ozone is made by high-tension electric discharge through air, hypochlorite by electrolysis of salt solutions. The author concludes that hypochlorite sterilization is much more economical than ozone treatment.—Lond. *Electrician*, June 4.

Units, Measurements and Instruments.

Measuring the Self-Inductance of a Coil.—E. C. SNOW.—In Pirani's method of measuring the self-inductance of a coil it is assumed that the self-inductance of the galvanometer used may be neglected. That this assumption is legitimate in the case in which the discharge of the condenser employed (which is of the same nature as the discharge through the galvanometer) is continuous has been proved. The object of the present analysis is to investigate the case in which the discharge of the condenser is oscillatory. A condenser of capacity C, the "internal" resistance of which can be neglected, is placed in series with the coil whose self-inductance is to be measured (Fig. 3). The condenser is shunted by a non-inductive resistance r. This combination forms one arm of a Wheatstone bridge, the resistances of the other arms of which are adjusted so that a steady balance holds between the four arms. One or the other of two methods can now be used. (1) Keeping r constant, C can be varied until there is no throw on closing the galvanometer-key before the battery-key; or (2) keeping C constant, r can be varied, the total resistance of the arm being kept constant, until the same result is arrived at. The result of the author's analysis is that in the case of the oscillatory discharge of the condenser, with a constant e.m.f. the relation $L = Cr^2$ holds. Hence the expression for the inductance of the coil is independent of the inductance of the galvanometer.—*Phil. Mag.*, June.

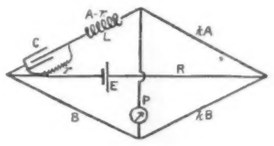
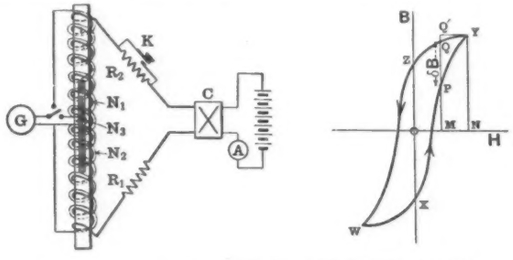


FIG. 3.—MEASURING INDUCTANCE OF A COIL.

Hysteresis Loss Measurements.—R. BEATTIE AND P. M. ELTON.—Ballistic methods of measuring hysteresis are very accurate, but have the disadvantage that they are generally troublesome. The authors describe a method that is quick in operation and has the advantage that it refers to short test pieces. Instead of obtaining the B-H curve, the δB-H curve is found by a differential measurement, the method preferred being that of momentarily short-circuiting a resistance in the magnetizing circuit so that H is brought up to its maximum value and immediately returns to its previous value, a single specimen being used. The conditions for the interval of short circuits are examined. The results are satisfactory, but the authors find that the loss in a ring is 16.5 times that found in strips, whether by the differential or the step-by-step method. Finally, some differential methods involving two specimens are described. The arrangements in the differential method are shown diagrammatically in Fig. 4. Essentially they are the same as for an ordinary ballistic test, except as regards the means employed for varying the magnetizing current. For this purpose a tapping key K is connected up so as to permit the short-circuiting



FIGS. 4 AND 5.—MEASURING HYSTERESIS LOSSES.

of a part R_2 of the resistance in series with the magnetizing coil. The course of an experiment is to start by rocking the commutator C, the key K being held down meanwhile. After one or two reversals the commutator is stopped in its mid position, which interrupts the current and leaves the magnetism at the point X (Fig. 5). Next K is opened and the commutator thrown over in the direction in which it was last moving. This carries the magnetism to the point P, which corresponds to a magnetizing force $OM = H$, measured by the observed reading of the ammeter A. These preliminary adjustments having been made K is closed momentarily and the resulting ballistic throw noted. During the short interval that K is closed the induction has time to rise from PM to YN, and, on opening K, it falls to QM; hence, the total change of induction during the operation is $PQ = \delta B$, which, therefore, is what the throw of the ballastic galvanometer measures. In this way two related values of H and B are obtained. To obtain others the whole of the above process is repeated with different values of R_2, the value of R_1, which determines the size of the hysteresis loop, being kept fixed. The conditions for the success of the method are described. The article is to be concluded.—Lond. *Electrician*, June 4.

Exhibition of Instruments; Flux Meter.—J. Reyval.—A continuation of his illustrated description of the various instruments exhibited at the recent exposition of the French Physical Society of Paris. They include an absolute electrodynamometer of Pellat and Carpentier, the "hysteresigraph" of Abraham and Carpentier, the monophone receiver of Abraham, new transformers of Rochefort and Jaiffe for wireless telegraphy, and the flux meter of Grassot. The latter is shown in Fig. 6. It is intended as a substitute for the ballistic galvanometer and permits the measurement of the quantity of electricity passing through a small non-inductive resistance of a known value; or the measurement of the intensity of a uniform magnetic field, when the apparatus is connected to a coil of a known number of turns and of known surface. B is a galvanometer of the Desprez d'Arsonval type, with a moving coil in uniform magnetic field, the current being introduced through the spirals r and r' of very fine silver wire. An exploring coil G of a known number of turns and of known surface is connected to the terminals of the apparatus. When this coil is placed in a magnetic field the magnetic flux will be indicated by the needle of the flux meter. The needle returns to its original position

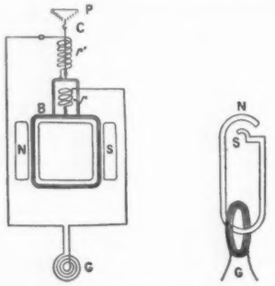


FIG. 6.—FLUX METER.

when the coil G is removed from the field. For experiments which last only a few seconds the indications are practically errorless.—*La Lumière Elec.*, May 29.

Series Transformer.—K. A. Sterzel.—An illustrated article on a series transformer for measuring instruments, giving details of the corrections which are to be applied on account of the change of the ratio of transformation with the load and on account of the phase difference which is to be noted.—*Elek. Zeit.*, May 27.

Braun Cathode-Ray Tube.—F. Giesel and J. Zenneck.—The well-known Braun cathode-ray tube has the disadvantage that the light intensity of the luminescent substances used in the tube is not sufficient for photographical instantaneous pictures in the case of relatively rapid varying currents. The authors have found that the use of zinc sulphide is useful for such purposes.—*Phys. Zeit.*, June 1.

Induction Meter.—An official note of the Reichsanstalt by which an induction meter for three-phase and two-phase systems is admitted for calibration and its construction and calibration are described.—*Elek. Zeit.*, June 3.

Telegraphy, Telephony and Signals.

Telegraph Cables.—The submarine cables of the world have increased during the last 10 years by 594 cables with 163,921 km length. The total cable network of the world at the end of March, 1908, was 1651 cables owned by the governments of different countries, with 84,155 km length, and 402 cables owned by private companies, with 380,697 km length. The total is, therefore, now 2053 cables with 464,852 km length. How the different countries participate in this total is shown in the following table:

England, incl. Pacific c'h'l.	253,898 km.	Japan	8,084 km.
United States, incl. P. I.	92,818 km.	Netherlands	5,721 km.
France	43,115 km.	Spain	3,565 km.
Germany	30,167 km.	Italy	1,989 km.
Denmark	17,771 km.	Sundry countries	7,724 km.

Some notes are given on the progress of Germany in cable construction during the last years.—*Elek. Zeit.*, June 3.

Protection of Telephone Installations Against Induction Effects.—M. Hoechstädter.—To protect telephone installations against the disturbing effects of induction from alternating-current transmission lines, a method is useful in which by

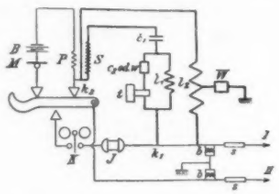


FIG. 7.—DIAGRAM OF ARRANGEMENT.

means of very small condensers a certain selection is made between the disturbing low-frequency induction current and the telephone current with a much higher frequency. The most suitable arrangement is shown in Fig. 7, where B is the battery, M is the microphone, K is a bell, J the inductance coil, c_1 is the small condenser which is intended to keep off the disturbing low-frequency current from the telephone receiver t. To take care of that part of the disturbing current which nevertheless passes through c_1 the inductance coil l_1 is provided in parallel with the telephone receiver t which is in series with a larger capacity c_2 or preferably a suitable resistance w. The method has proved very useful in connection with a 10,000-volt, three-phase transmission line of 30 km length. In this case the capacities, etc., had at the following values: $c_1 = 0.06$ microfarad, $w = 1000$ ohms, $W = 0.1_1 = 0.25$ henry, $1_2 =$ one or more henrys, $c_2 = 1$ microfarad.—*Elek. Zeit.*, June 3.

Protection of Telegraph and Telephone Lines.—The official regulations of the German Government for protection of telegraph and telephone lines from electric transmission lines other than for traction.—*Elek. Zeit.*, June 3.

Wireless Telegraphy.—H. M. Macdonald.—A mathematical note on the theory of directed wireless telegraphy by means of horizontal receivers and transmitters. The essential feature of the various systems of directed wireless telegraphy is the interference of two sets of waves differing in phase and proceeding from sources at a distance apart.—Lond. *Electrician*, June 4.

Wireless Telegraphy and Telephony in a Certain Direction.—E. Bellini and A. Tosi.—An illustrated description of their method of direct wireless telegraphy which has already been noticed in the Digest.—*Elek. Zeit.*, May 27.

Miscellaneous.

Slide Rule for Calculating Boiler Efficiency.—A note on a novel type of slide rule designed to facilitate comparison of actual figures of water evaporated per pound of coal, when the feed water and also the stream are at temperatures other than 212 deg. Fahr. The percentage over-all working efficiency of boiler and furnace can also be ascertained. There are four

logarithmically graduated scales, and the method of operation is as follows: The known feed-water temperature is set opposite the actual evaporation per pound of coal burned; this allows the equivalent evaporation—from water at 212 deg. Fahr. at a boiler pressure of 150 lb., and also from water at 212 deg. Fahr. at atmospheric pressure—to be read off from two pointers. If the rule is then turned over, the thermal units transmitted to the water and steam for each pound of coal burned and the percentage efficiency (with coal of 14,000 b.t.u.) are indicated on the scales at the back. Corrections are provided for differences of boiler pressure, for superheat or wetness of the steam, and for coal of other quality.—Lond. *Electrician,* June 4.

Finsen Treatment.—The first part of an article on the construction of arc lamps for the use in the Finsen treatment of skin diseases. The light rays of wave lengths from 490 to 390 (blue and violet) and the longest waves of the ultraviolet rays (with wave lengths from 390 to 350) are effective. The green, yellow and red rays on one side and the shorter ultraviolet waves on the other side must be filtered out.—*Elek. Anz.,* May 20.

Marseilles Congress.—A full account of the proceedings of last year's International Congress of Applied Electricity held at Marseilles. The proceedings at the sessions of the different sections were summed up and such resolutions as were adopted are given.—*La Houille Blanche,* January and February. Descriptions of various exhibits in connection with the congress in *La Houille Blanche,* March, April and May.

BOOK REVIEWS.

CONTROLE DES INSTALLATIONS ÉLECTRIQUES (APPENDIX). By A. Monmerqué. Paris: Ch. Béranger. 310 pages.

This book forms the Appendix to a previously published volume of the same author, subject and title. The appendix contains a digest of the various laws, ordinances and decrees that have been promulgated in France and are still in force on the installation of electric plants and conductors. A good index is provided at the end of the volume as a key to the mass of material included. To those interested in municipal and government regulation of electric installations the material collected in this work should prove useful.

LOGARITHMS FOR BEGINNERS. By Charles N. Pickworth. New York: D. Van Nostrand Company. 47 pages. Price, 50 cents.

This little manual contains tables of four-place logarithms and antilogarithms, together with simplified explanations of their use and examples for practice. Particular emphasis is laid on the facts upon which logarithms are based, so that the beginner learns to use the tables by ascertaining the significance of the values contained therein. The book is now in its second edition and is free from certain numerical errors which appeared in the first edition. Its use by any one familiar with algebra should cause him to understand logarithms thoroughly and use them with ease.

AMERICAN ELECTRIC RAILWAY PRACTICE. By A. B. Herrick and E. C. Boynton. New York: McGraw Publishing Company. 403 pages, 223 ills. Price, $3.

This book presents a compilation of matter relating to the construction, operation and maintenance of street and interurban railways in America. The subjects covered are preliminary estimates, field engineering for interurban roads, railway track construction, location of power station, overhead circuit, time-table and schedules, train dispatching and signals, rolling stock, car houses and repair shops and the maintenance of tracks, overhead lines and rolling stock. The treatment is almost wholly descriptive, practically no theory being discussed, and mathematical equations are completely avoided. The book can be considered as recording those constructive features and operating practices that at present are found most satisfactory in street-railway service.

EINFÜHRUNG IN DIE THEORIE DES MAGNETISMUS. By R. Gans. Leipzig: B. G. Teubner. 108 pages, 40 ills. Price, 2.40 marks.

The book is a mathematical treatise on the theory of magnetism, and deals with the subject from the standpoint of Gauss and his contemporaries. It does not pay much attention to the modern development of magnetic theory, since the advent of the dynamo machine. Very little appears about magnetic flux generally. The fact that metallic reluctivity in iron is a linear function of magnetic force does not appear. The work is more suitable for the mathematical physicist as a study than for the applied physicist as an up-to-date text-book.

THE ELECTRIC FURNACE IN IRON AND STEEL PRODUCTION. By John B. C. Kershaw, F. I. C. London: The Electrician Printing & Publishing Company. 68 pages, with appendix, 24 ills. Price, $1.50.

This is a reprint of a series of articles which originally appeared in *Iron Trade Review* and *The Electrician* (London) in 1906. The opening chapter is a brief historical review of the work done in this line, followed by chapters devoted to the processes of Héroult, Keller, Kjellin, Stessano and others. They present but the main features of each of the processes and contain some good illustrations. The best feature of the whole is the chapter on yields and costs, in which the author has collected in an easily comparable form the chief data of the report of the Canadian Commissions and the well-known papers of Neumann and Goldschmidt. An appendix contains a brief description of the Colby induction furnace and, of more importance, the numbers of the British, Canadian and American patents granted each of the four principal workers in this field. The whole gives a good presentation of the subject.

DUMB NO LONGER. Romance of the Telephone. By Fred. De Land. Washington: Volta Bureau. 285 pages, ills.

The preface states that the object of this work is to trace the steps that led to the invention of the telephone in Massachusetts. To this end a history is given in great detail of the evolution of the methods of teaching deaf-mutes, the greater portion of the volume being devoted to this subject. This matter is introductory to an account of the connection of Alexander Graham Bell with the invention of the telephone, though the relation of the two sections appears rather slight. The account of Professor Bell's work is highly laudatory, this section, in fact, reading far more like a brief of the days of telephone patent litigation than as an impartial contribution to the history of telephone invention. Reis and Gray thus naturally fare badly; Wilber, the Patent-Office examiner, for example, is accused of perfidy in behalf of Gray. The work, nevertheless, will be found of interest as setting forth in minute detail an ex-parte account of the Bell invention, which may also be accepted as an authoritative version in view of the book bearing the imprint of the Volta Bureau.

THE METALLURGY OF IRON AND STEEL. By Bradley Stoughton. New York: Hill Publishing Company. 487 pages, 311 ills. Price, $3.

This book of Professor Stoughton occupies an intermediate position in the literature of iron and steel. It hardly goes deep enough into the details of the art to make the book useful to the active steel metallurgist, but rather is intended as a text-book for college and university work, or as a general reference book for the mechanical, electrical or civil engineer who desires to familiarize himself with the manufacture and properties of these two materials. While the text presumes a knowledge of physics and chemistry, as an after-thought, apparently, an elementary chapter on these two subjects was added at the close of the book. Separate chapters are devoted to the manufacture of pig iron, wrought iron, Bessemer and open-hearth steel. Excellent chapters deal with the founding and mechanical treatment of steel. The theoretical side of the subject, including metallography, is briefly touched upon. The crown-

ing feature of the book is its illustrations, which, for care in selection and excellence of reproduction, are probably not surpassed by any book on the same subject in any language. As a general and modern work on the subject the book deserves a place in the library of every engineer who comes in contact with these metals.

Alternating-Current Machines. By Samuel Sheldon, Hobart Mason and Erich Hausman. New York: D. Van Nostrand Company, 353 pages, 236 ills. Price, $2.50.

The book has been rewritten and modernized in many ways. Brief descriptions are given of the recently developed single-phase commutator motors. Alternators, transformers, induction motors, synchronous motors and transmission systems are discussed at some length. In each case the treatment is arranged with special reference to the needs of the student.

Approximately one-third of the volume is devoted to introductory matter relating to the properties of alternating currents and characteristics of alternating-current circuits. While the matter is, as a rule, handled in an instructive manner, the explanation of "resonance" is more apt to mislead the reader than to instruct him. The statements that when capacity and inductance are in parallel a surging once started between them receives periodical increments of energy from the line, and that the action is "analogous to the well-known mechanical phenomena that a number of gentle, but well-timed, mechanical impulses can set a very heavy suspended body into violent motion," will certainly not be properly interpreted by an uninformed reader. The average student would believe that if a condenser taking, for example, 10 amp at 100 volts and a purely inductive reactance taking the same value of current at the same e.m.f. were joined in parallel and subjected to 100 volts, the circuits would gradually build up current to a destructive value, when as a matter of fact the condenser acts just as though the reactance were not present, and the action of the reactance is independent of the connection of the condenser, just as is true of any two receivers joined in parallel. The difficulty encountered by students in understanding the so-called "resonance" phenomena would be greatly decreased if writers would omit the confusing reference to mechanical analogues.

The authors have given excellent outlines of the characteristics of the various types of alternating-current machines. The descriptive matter relating to the various types of apparatus is somewhat brief, but it is to the point and covers the features of interest sufficiently for the ordinary needs of the engineering student.

NEW APPARATUS AND APPLIANCES

Variable-Speed, Single-Phase Motor for Organ Bellows.

One of the interesting power distribution problems of alternating-current central stations has been that of satisfactorily driving church organ-bellows with single-phase motors. In general, the most satisfactory means so far applied has been a low-pressure blower of some form driven by a constant-speed motor, the movement of the organ-bellows regulating the admission of air to itself. Such arrangements have, however, been considered inapplicable in some of the smaller churches, due to the cost of the equipment. The illustrations herewith show a simpler type of installation in the German Reformed Church of New Brooklyn, at Brooklyn, N. Y. It consists of a 2-hp, variable-speed, single-phase motor belted to the driving shaft of the bellows through a simple countershaft. Speed variation is secured by means of an ordinary regulating rheostat in the field circuit of the motor, the amount of resistance in circuit being determined by the position of the bellows. This equipment has been running for two years or more, and has been found entirely adequate to all requirements, being simple, quiet running and practically self-controlling and automatic in every feature. The organist closes the main line switch, and the equipment thereafter regulates itself to the needs of the organ. The motor was built by the Wagner Electric Manufacturing Company, of St. Louis, Mo.

FIG. 1.—ORGAN BELLOWS DRIVEN BY SINGLE-PHASE MOTOR ON CEILING BELOW.

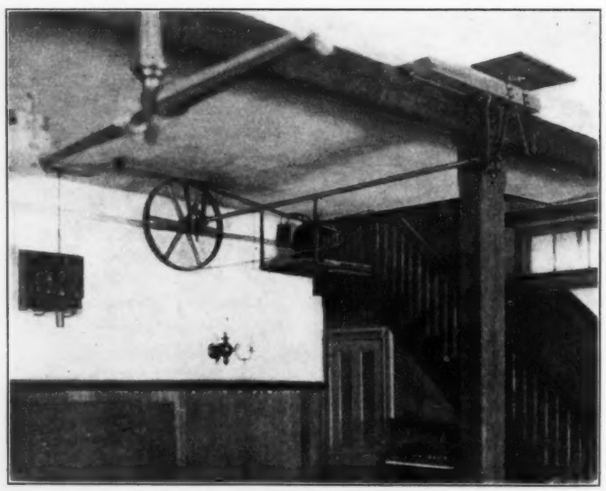


FIG. 2.—SINGLE-PHASE MOTOR FOR DRIVING ORGAN BELLOWS.

Tungsten Anti-Vibrator and Shop Cluster.

The American Arc Lamp Company, Kalamazoo, Mich., has added to its specialties a device named "Tungsten Life-Saver," having for its object to prevent injurious shocks from vibration to the delicate filament of tungsten lamps. The arrangement of the parts admits of a free lateral or oscil-

lating motion within a limited area, and the helically coiled spring used is extremely sensitive. The device is made in suitable sizes or strengths to suspend fixtures or clusters weighing from 4 lb. to 15 lb. or more. It can be readily installed with any standard fixture, and where used in stores or offices it may be entirely concealed by a ceiling canopy. It is

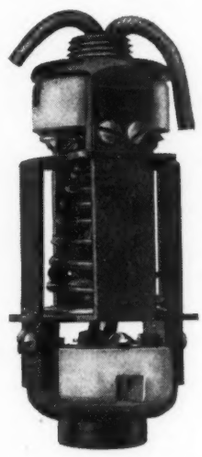


FIG. 1.—TUNGSTEN LIFE-SAVER.

attached to the ceiling by means of an ordinary crowfoot, and in steel buildings by an insulating joint.

Following its established plan of making shop lighting a specialty, the same company has developed and placed on the market an inexpensive tungsten shop cluster, made entirely from steel, with a plain black finish. The special features of this cluster are the 18-in. steel, porcelain-enameled shade, and the light distributing cone. The latter extends down from the center of the receptacle plate to a point about midway of the lamps, and being enameled in white porcelain presents a high reflecting surface, distributing the light downward and outward

FIG. 2.—TUNGSTEN SHOP CLUSTER.

into the zone where most needed. This cone also prevents the light of one lamp from being screened by the other. The tungsten shop cluster, in connection with the tungsten "Life-Saver," are offered by the manufacturers as a complete arrangement for shop lighting.

Exhibits at Cleveland Industrial Exposition.

Officials of the committee of the Cleveland Chamber of Commerce who had the Cleveland Industrial Exposition in charge state that at least 300,000 people visited the show during the two weeks that it was open and that 215,000 of these were paid admissions. The others were exhibitors, representatives of commercial and civic bodies from other cities, guests of the Chamber, press representatives and employees and deliverymen. Several million dollars' worth of business resulted from the exhibits, aside from the prospects secured and the advertising received. Exhibitors in electrical lines, especially in the automobile class, took quite a large number of orders, and in many ways profited through the exposition. In addition to the concerns previously mentioned in these columns, the following were among the exhibitors:

The A. & W. Sign Company had a magnificently lighted booth, in which a number of interesting flashing signs were shown in operation. The booth was enclosed with a framework of four white pillars, one at each corner, surmounted by illuminated globes. Curved beams extended from these pillars to a center ball, upon which was mounted a flagstaff with floating banner effect. In a case at the front of the display all the apparatus used in producing lighting effects was shown in operation. This proved of great interest to the people at large. This company furnished all the electric signs used in the exposition.

The General Incandescent Lamp Company had a booth built of dark wood-studded with lamps of all kinds, sizes and capacities. The effect of the white light on the dark woodwork was excellent. Within the enclosure all the lamps produced by the company were shown in cases, so that the visitors could examine them or talk business without being disturbed. Most of the lamps used in the two buildings occupied by the exposition were furnished by this company.

Regenerative flame arc lamps in various styles of enclosure, and opened up for the examination of those interested; lamps for blue print and photographic work; apparatus used in installing and operating arc lamps, as well as other products of the factory, were shown by the Adams-Bagnall Electric Company in the armory building.

In addition to a full line of batteries and the smaller products of the factories, the National Carbon Company had two immense blocks of carbon at the entrance to its booth. From the display made by this company a good general idea could be obtained of the various uses to which carbon and its products are put.

The Domestic Vacuum Cleaner Company displayed samples of its floor cleaners, which are in the shape of small portable machines to which the apparatus taking up the dirt is attached by a short hose. They are operated by electric motors and energy may be secured from an electrolier or bracket socket.

To carry out the idea of operation by electric energy, the Brock Carriage & Wagon Company had its booth decorated with lights in a very creditable manner. These with trailing vines and artistic arrangement of pillars and lattice produced a good effect. A coupé and stanhope comprised the exhibit, and they were excellent specimens of the company's product.

The Reliance Electric & Engineering Company exhibited several of its variable-speed motors, both individual and attached to machines where their use could be judged from operation. The speed of this motor is regulated by increasing or decreasing the field by moving the armature in or out. A new speed indicator was also shown in connection with a motor-operated planer. A variable speed reversible motor and several constant-speed motors made up the remainder of the exhibit.

The Baker Motor Vehicle Company showed two very handsome specimens of its product in the shape of a stanhope and a coupé. This company started in the manufacture of small runabouts, but is now producing many styles of electrically operated automobiles.

One of the largest automobile exhibits was that of the Rauch

& Lang Carriage Company, which had a victoria, a stanhope, two coupés, a surrey and a chassis. It is understood that the company did a very successful business at its booth, besides the prospects secured for the future.

The National Ticket Company showed all the styles of strip and single tickets turned out in its plant, as well as a turnstyle and ticket destroyer, with motor in the base. The latter machine is a very useful one for any company using a large number of tickets, as they may be destroyed and the scraps sold for old paper.

The Bruce-Macbeth Engine Company had in operation a 4-cylinder 135-hp gas engine. Its product may be adapted to any operation using power.

The Brown Hoisting Machine Company had a very creditable display of trolley and chain hoists of various kinds and capacities. Photos of some of its large installations were shown on the walls, and rough castings were displayed in other portions of the booth.

The Mechanical Rubber Company had both a merchandise and working display, which showed the wide range of its products, including belting, washers and rubber articles used for almost all purposes.

A large and handsome display of its products was made by the Cleveland Twist Drill Company. Drills of all sizes and for almost every conceivable purpose were to be seen in the cases in that booth.

The Standard Tool Company had an excellent display of twist drills and other articles turned out in its factory. The products were shown in glass cases and were arranged in such a manner as to attract much attention.

A welding machine was kept in continuous operation by the Standard Welding Company. This proved of great interest to people who are not acquainted with the methods used in electric welding.

New Type of Locke High-Tension Insulator

Fred. M. Locke, Victor, N. Y., announces that he has succeeded in making a new material for insulators which he calls "Transparent Porcelain," and which possesses a number of remarkable qualities. The base is aluuminum silicate, and the material can be melted and cast in the same manner as glass. Two of its most remarkable features are the temperature changes it will withstand, and its high specific inductive capacity. These, together with great mechanical strength and high resistivity, ideally fit the material for all classes of insulation.

FIG. 1.—HIGH-TENSION INSULATOR.

FIG. 2.—BUSHING.

The insulation shown in the accompanying illustration has been submitted to the following tests: Dry arcing at over 105,000 volts per section; wet arcing at over 55,000 volts per section; breaking test, 10,700 lb.; sudden change of temperature from 40 deg. to 200 deg. Fahr. without cracking. Its specific inductive capacity was found to be 10 as compared with air as unity, the corresponding figures for glass and porcelain being 2 and 4 respectively.

The bushing shown in the illustration was tested to 100,000 volts, its flash-over point, with scarcely any evidences of static effect. It is stated that a large number of the new insulators have been tested to 100,000 volts for several hours without any failures.

"Universal" Electric Flat-Iron.

The Central Electric Company, Chicago, is placing on the market a new type of electric flatiron known as the "Universal" iron, in which the desired heat distribution is secured by so locating the heating element that the edges and points of the ironing plates are initially hotter than the center. The location and construction of this heating element are clearly shown in

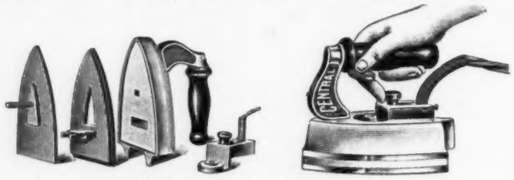
FIGS. 1, 2 AND 3.—ELECTRIC FLAT IRON.

Fig. 1 and the heating effect is illustrated by the burned paper diagram of Fig. 2.

Following are the results of some tests made with (1) the new "Universal" iron; (2) with a second type of iron on the market; and (3) the average of tests of seven other irons which have been on the market for the past two or three years:

	1.	2.	3.
Efficiency	60%	50%	39%
Consumption, watts	400	475	533
Time required to heat bottom plates to 250 deg. F., min	2	3½	4½
Temperature of top at same time, deg. F.	72	100	137
Time required to heat bottom plate to 500 deg. F., min	5	8	13
Temperature at top at same time, deg. F.	150	250	398

An iron "snaps" at approximately 250 deg. Fahr. The ordinary domestic iron is better at 400 deg. Fahr. and the average laundry iron at approximately 500 deg. Fahr. Referring to the above data it will be noted that on the basis of 250 deg. Fahr. at the bottom of the iron, the temperature at the top of various types of irons varied from 72 deg. to 137 deg. Fahr.; and with a temperature of 500 deg. at the bottom of the iron the temperature at the top of the same irons varied from 150 deg. to 398 deg. The new iron was found much superior to the other



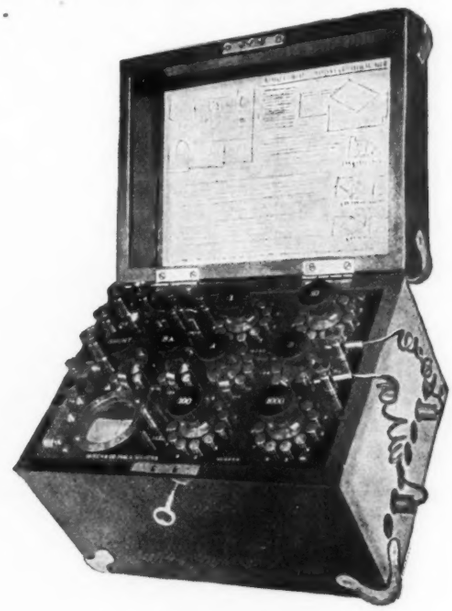
FIGS. 4 AND 5.—ELECTRIC FLAT IRON.

irons tested in that the top of the iron ran much cooler, less heat being thus radiated and wasted from this surface.

Fig. 3 illustrates the improved iron, and Fig. 4 the various elements. It will be noted that the heating element is firmly clamped between the body of the iron and the ironing plate, which in the cut is shown in the reverse position, illustrating the method by which it is bolted to the upper element. Fig. 5 shows the method of operating the heat-regulating switch, by the use of which the operator can keep the iron at a definite temperature with a minimum consumption of energy. The 6½ lb. "Universal" iron requires approximately 400 watts, which low consumption of energy meets the objection sometimes urged against other types of electric irons on the score of cost of operation.

A New Dial Decade Set.

The illustration herewith shows a new type of portable testing set being placed on the market by Queen & Company, Philadelphia. This set is very small and compact, measuring but 9¼ in. long by 7 in. wide by 7½ in. deep and weighing about 11 lb. It is equipped with a new form of rheostat consisting of four complete dials of 10 coils each, of the capacity of units, tens, hundreds, and thousands, so arranged that the revolving laminated brush may be changed from the highest to



DIAL DECADE SET.

the lowest coils without revolving backward over the intermediate contacts, thereby saving considerable time in manipulation. The bridge arm *A* has coils of 10, 100, 1000 and 10,000 ohms and also a block "infinity" or no resistance. The *B* arm has coils of 10, 100, 1000 and 10,000, and also a zero block, which short-circuits the *B* side when switch is on zero. It will thus be seen that a very wide range is allowed.

The type of brush designed for this set is of the tripod form, with two legs of the tripod resting on the central contact ring, thus doing away with the annoying and variable stud contact as usually made in switch-type sets. The third leg rests on the block as indicated by the position of the brush. It will be noticed that by this arrangement no flexible lead or variable stud can enter into the resistances of the rheostat or bridge. Each of the necessary switches and binding posts is plainly marked and conveniently arranged so that the operator may quickly make Wheatstone bridge, Murray and Varley loop tests for insulation measurements, and numerous other tests.

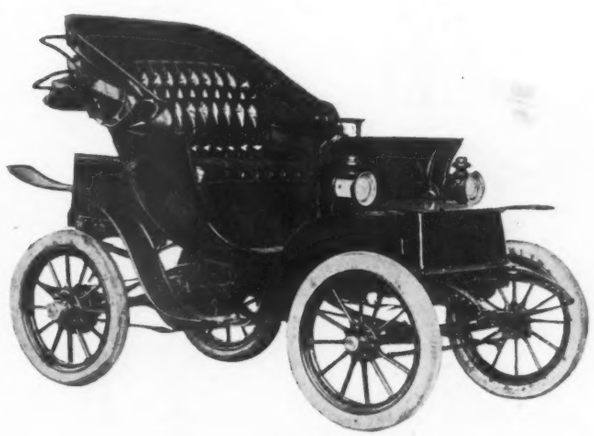
The scale on the galvanometer is so calibrated as to make the readings for insulation uniform throughout the entire range of the scale. The resistance coils are wound with manganin wire, of zero temperature coefficient, shellacked, and backed; the resistance, therefore, requires no correction over very wide ranges of temperature. The galvanometer is of the D'Arsonval type, with a long narrow coil, securing thereby a high sensibility, with dead-beat action.

The magnets are made of the finest grade of magnet steel, carefully aged and tested, and are permanent and uniform. A specially arranged Ayrton shunt allows a very wide range of application, making it possible to allow full current to go through the galvanometer or 1/10 or 1/100 part of the same. Keys in series with both battery and galvanometer circuits are so arranged that they can be kept locked down when it is desired to make permanent contact, by means of a thumb-nut at the back of the strap; or both keys may be depressed with the same finger when necessary. Provision is made by means of binding posts for the use of an outside battery of higher e.m.f. than that furnished with the set, when stronger battery power is needed. An outside galvanometer may be used when an instrument of higher sensibility than that furnished in the set is desired. The battery consists of six special dry cells mounted in the base. For the renewal of the batteries it is only necessary to remove four small screws from the base of the case, thereby opening the cell compartment, and the battery can then be renewed without soldering or rewiring any connections. This cell compartment is made entirely separate from the rest of the case and securely sealed, there being no danger when changing the battery of getting any dust or dirt into the interior of the set, or around the galvanometer or resistance coils. The card of direction in the lid describes the connections of the set and also the diagram of the wiring as used in the different tests, together with printed descriptions and formulas. The case is of polished mahogany, highly finished, with nickel-plated corner straps to protect from injury. This set is being placed upon the market under the name of the "Queen Dial Decade Set."

Electric Pleasure Vehicle.

Among the various electric pleasure vehicles manufactured by the Studebaker Automobile Company of South Bend, Ind., the phaeton illustrated herewith is one of the most popular. The vehicle has a wheel base of 71 in. and a gage of 48 in. The tires on the front and rear wheels are 3½ in. Semi-elliptical and full elliptical springs are used on the front and rear axles, respectively. A Westinghouse motor rated at 48 volts and 26 amp is suspended from the chassis frame and is controlled by a Studebaker type, continuous-torque controller giving four speeds and shunt forward and three speeds reverse; a cut-out switch also being assembled in the starter. Ball bearings are used on the motor and axles so as to limit friction to a minimum.

Two brakes are provided;. one a constricting brake on the armature shaft drum, operated by the controller, and the other is of the internal expanding type, operating through a foot



ELECTRIC PLEASURE VEHICLE.

pedal on both rear wheels. A side lever is used for steering. The battery equipment comprises 26 cells of Exide battery; two trays holding five cells each being placed over the front wheels and two trays holding eight cells each being placed over the rear wheels. The weight of the vehicle complete with top is said to be 2170 lb. The minimum charging voltage essential is 67.75 and 28 amp is required when starting to charge. The minimum number of amperes which should be available on the charging circuit is 42 and the kw.-hours required for full charge is 11.3 net, or 18.4 from a 11-volt circuit.

Adjustable Rheostats.

The Central Laboratory Supply Company, Lafayette, Ind., has recently placed on the market a line of adjustable rheostats adapted especially for meter testing, photometry work, lamp manufacture and other purposes where a continuous and close regulation of current is required. The complete line comprises several hundred rheostats of different capacities and resistances, covering sizes for almost any purpose designed.

The resistance wire is wound on a sheet-metal cylinder which has been previously covered with a thin layer of fireproof insulating material. The wire is wound under tension, and is afterward enameled, which, combined with the elasticity of the

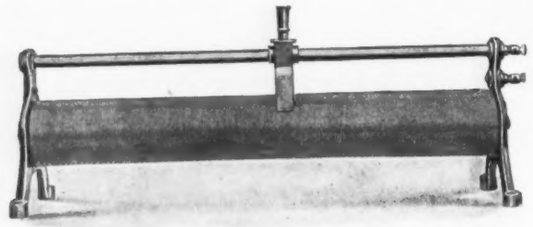


FIG. 1.—ADJUSTABLE RHEOSTAT.

insulating material, keeps the wire tight at all temperatures. The tube is mounted on ornamental cast-iron brackets placed at the ends, and held by a bolt passing through the tube. The openings in the brackets admit of a passage of air through the tube, which materially assists in the radiation of heat. The feet of the rheostat are fitted with rubber tips to prevent marring the desks or tables. They are also drilled through and countersunk, so that the rubber tips can be removed and the rheostats mounted in either a horizontal or a vertical position, and fastened with screws. A round bar extends the full length of the tube and carries a sliding contact of special design. The contact portion is made of a number of thicknesses of thin copper and tension applied by a phosphor-bronze spring, so that there are several independent contacts present on the wire at all times. The contactor, which is fitted with an insulated handle, has a smooth and even sliding motion, making it possible to make accurate adjustments without difficulty. Two brass binding posts, mounted on the frame, are connected to the ends of the resistance coil and the third to the contactor. This arrangement makes it possible to use the rheostat as a series

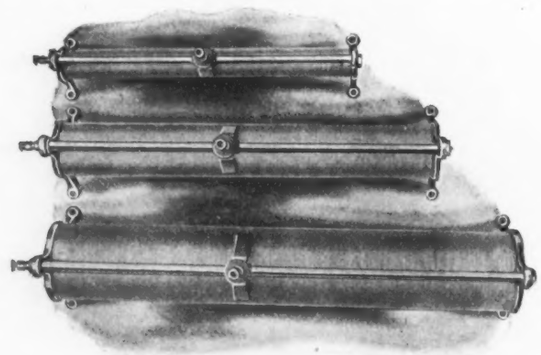


FIG. 2.—THREE SIZES OF RHEOSTATS.

resistance or to place it across the circuit of a given potential and obtain between one end of the coil and the contactor any value of e.m.f. from zero to the voltage across the coil.

The rheostats are at present made in three sizes, as follows: Length, 16 in.; diameter of tube, 1½ in.; weight, 2¾ lb.; resistance of ½ ohm, with 60 steps to 525 ohms and 575 steps. Length, 20 in.; diameter of tube, 2¾ in.; weight, 6 lb.; resistance of 1 ohm and 80 steps to 1300 ohms and 650 steps. Length, 24 in.; diameter of tube, 4½ in.; weight, 10½ lb.; resistances of 4 ohms and 135 steps to 2000 ohms and 735 steps. The three sizes are made in current capacities from ½ amp to 15 amp.

The wire with which these rheostats are wound has a negligible temperature coefficient, and is guaranteed not to deteriorate under repeated heating and cooling. The contactor, rod, and binding posts are polished and lacquered; the rest of

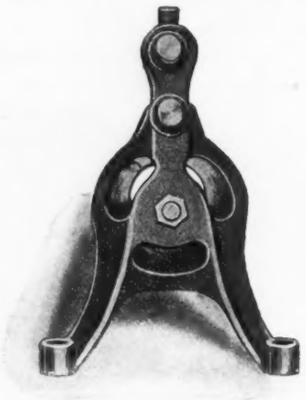


FIG. 3.—END VIEW OF RHEOSTAT.

the parts, including the coil, are finished in black baked enamel. The bar which carries the sliding contact also makes a convenient handle. These rheostats are intended for commercial and technical laboratories for controlling currents, calibrating instruments, and in various lines of commercial and experimental work.

Small and Large Tungsten Lamps.

In addition to the usual standard type of tungsten lamp heretofore imported, the Electrical Accessaries Company, of New York, is placing on the market an 18-watt tungsten for 100 to 120-volt multiple circuits. A view of this lamp, which is the smallest at present made for such service, is shown in the accompanying engraving. The company is also bringing out a 40-watt tungsten lamp for 200 to 250-volt circuits, which will doubtless be welcomed by users of high voltage current who have been obliged heretofore to burn two lamps in series, because no high-voltage lamp of low wattage was obtainable. Another

TUNGSTEN LAMP.

tungsten lamp which the company is importing for distribution here is rated at 400 cp. This lamp is intended for replacing arc lamps. Its specific consumption per candle-power is about the same as that of the arc lamp, while the upkeep and maintenance are considerably less. The lamps have been tried out abroad and have given satisfaction. The company has adopted a new trade name for its line, which will hereafter be known as "Justram" lamps, a contraction of "Just Wolfram," by which the line has heretofore been distinguished.

Electric Hat Chuck.

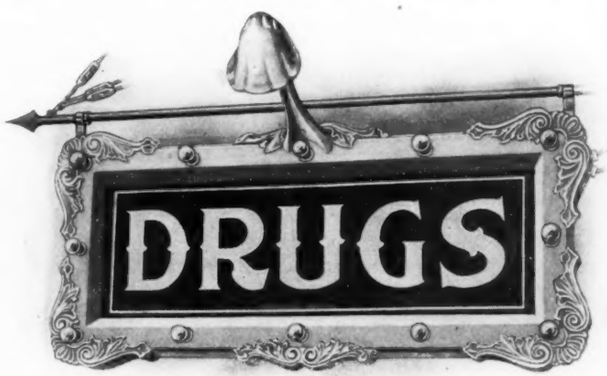
A novel and labor-saving device for holding and rotating hats is shown herewith. The device is manufactured by the Saylor Electric Company of Pittsburgh, Pa., and its main feature is that it fits any size of hat automatically and requires no adjusting whatsoever. The four shoes shown operate just like the

ELECTRIC HAT CHUCK.

weights on a fly-ball governor under the action of centrifugal force, and hold the hat firmly as long as the motor is running. When the motor stops the hat is released. Direct-current or alternating-current motors with large and rigid bases are employed. These are designed for 110-volt circuits, and in the case of the alternating-current motor for 60 cycles.

Electric Sign with Reflector Arm.

A recent addition to the familiar electric sign made by the Federal Electric Company, of Chicago, is a type provided with reflector arms, as illustrated herewith. The frame of the sign is studded with 2-cp carbon lamps in the usual manner, but in



ELECTRIC SIGN WITH REFLECTOR ARM.

addition there is provided for each face of the sign a 40-watt or 60-watt tungsten lamp placed in a shell-shaped reflector attached to an arm extending out about 2 ft. from the upper part of the sign, as shown. The reflector arm is of metal and painted white, the inner surface of the reflector being of white enamel. Two reflectors are required, of course, where the sign is of the type shown in the cut, having two surfaces and intended to be supported over the sidewalk. The light from the large tungsten lamp is directed down on the lettering, and makes the latter especially brilliant. With this arrangement it is quite practicable to use lamps of low candle-power in the border outline. For longer signs than that illustrated two or more reflectors are provided for each surface.

Reflector Bowl Unit.

A new reflector bowl unit is being placed on the market by the Holophane Company, which consists of a strong concentrating type of reflector above the lamp with a special Holophane hemisphere below. The prisms of the hemisphere are

FIG. 1.—REFLECTOR BOWL UNIT.

quite shallow so as to reduce to the lowest possible degree any accumulation of dust. As will be seen from the accompanying photometric curves, the new unit gives a very desirable distribution of light, ranging from 70 cp at 45 deg. angle to 55 cp directly under the unit when equipped with 60-watt clear tungsten lamps. The manufacturers consider that the complete unit has a wide field of usefulness in office buildings, stores,

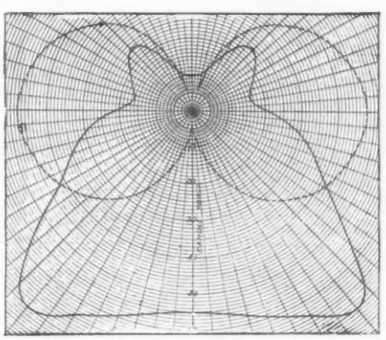


FIG. 2.—PHOTOMETRIC CURVES.

clubs, etc., where beauty, efficiency and diffusion of light are of about equal importance. In offering these fixtures the Holophane Company announces that it is not entering into competition with established fixture houses, but aims only to furnish equipment for some of its special glassware which other fixture manufacturers are not as yet ready to supply.

Philadelphia Office Building Installation.

The 10-story Lafayette Building recently erected at Fifth and Chestnut Streets, Philadelphia, is of modern construction, and serves as a striking illustration of the important place which electricity now holds in office buildings. Electricity is used not only for operation of the elevators and for illumination, but for floor cleaning throughout the building, for maintaining a supply of iced drinking water, and for insuring against the danger of fire. The energy required for the motors and lamps is furnished by a power plant on the premises, working in conjunction with another situated nearby in the Mariners' and Merchants' Building on Orianna Street. Both of these plants are owned by the Girard Estate and it is planned by combining the two to secure the greatest efficiency of operation and to provide against the possibility of interruption of service.

The Lafayette Building plant supplies electrical energy for over 5000 lamps on a three-wire, 110-volt system. The unbalance is taken care of by two small balancing sets. An idea of the extent of the system can be obtained from the fact that it requires over 5000 lb. of copper and 100,000 ft. of conduit.

One of the features of the plant is a board from which all the pumps are controlled. These are arranged to start and stop automatically and this, in addition to the fact that the controlling devices are concentrated on one board, does away with a large amount of attendance, which would otherwise be necessary. This board is entirely distinct from the main switchboard. Directly behind the pump control board and in another room are situated the pumps, surge and pressure tanks, and filters. The elevators, while they are propelled directly by hydraulic machinery, depend on electric drive to maintain the necessary pressure. This is supplied by three compound-wound motors, connected by belts to three Laidlaw-Dunn-Gordon horizontal triplex pumps. The sets operate almost noiselessly, a necessary feature for this class of service. The pumps are controlled by the regulating devices on the board to a variation in water pressure of not more than 10 lb. There are two pumps to supply the house tanks. These are Deane, triplex, driven through chains by 15-hp motors, and are furnished in duplicate to insure steadiness of service.

An ammonia refrigerating machine, driven by a 15-hp motor, is used to cool the drinking water. A system of heavily insulated pipes supplies iced drinking water to all rooms in the building, and the water is kept constantly in motion by means of a motor-driven circulating pump. With this arrangement the temperature of the water is kept down to 38 deg. or under, even in the hottest weather. The fire pump, which is also electrically

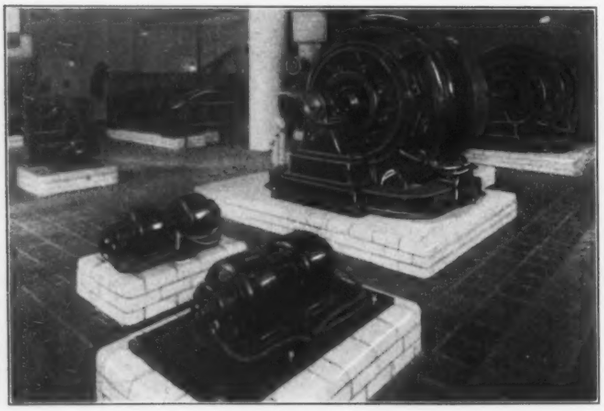


FIG. 1.—VIEW OF ENGINE ROOM.

driven, is of the rotary type manufactured by Rumsey & Company, and is capable of delivering 750 gal. of water per minute. The pipes carrying the normal supply are cross-connected with the fire lines, so that a supply of water may be taken from the latter at a lower pressure up to the time the pump is started.

For cleaning purposes a machine of the vacuum-air type is located in the engine-room. This machine is driven by a 20-hp motor, and is connected by pipe lines to all the rooms in the building. The pipe lines are further connected by means of flexible hose to attachments either for sweeping or scrubbing the floors. The former attachment permits the dust to be sucked through the piping to the machine, and afterward cremated by suitable apparatus situated on the premises. The

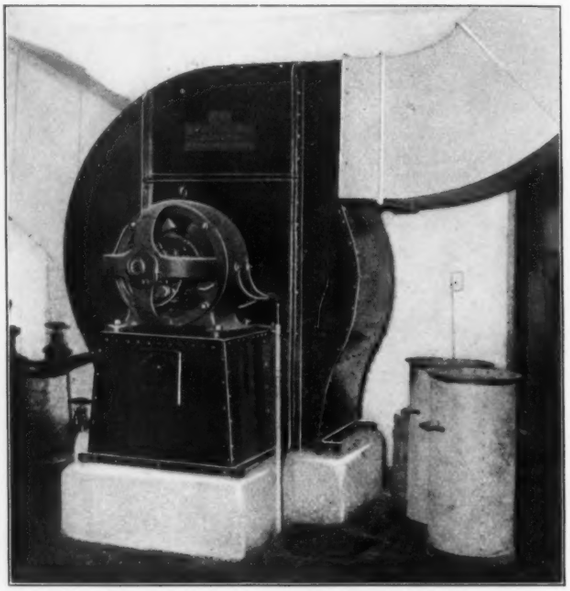


FIG. 2.—4-HP MOTOR DRIVING BLOWER.

scrubbing device, which is of more complicated construction, is adapted to cleaning marble floors with water and does away with a large amount of labor.

Electrical energy is generated in both plants by 250-volt, compound-wound generators. In the Orianna Street plant, which has a rating of 550 kw, the generators are driven by Rice & Sargent engines. The Lafayette Building plant, of 300 kw rating, employs two 250-hp side-crank Harrisburg engines as prime movers, taking their steam from two 250-hp Parker boilers. As the requirements of both buildings are just suffi-

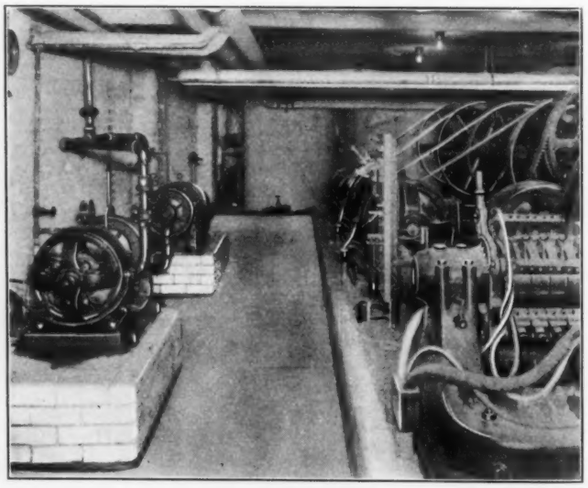


FIG. 3.—ELECTRICALLY DRIVEN PUMPS.

cient to load the Orianna Street plant up to its most efficient operating point, this plant alone is used during the summer months, while during the winter the plant in the Lafayette Building is also employed, its exhaust steam being used for the heating system. The entire electrical equipment was furnished by the Crocker-Wheeler Company, of Ampere, N. J.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

The tendency during the past week in general trade has continued to be toward improvement, and, especially in manufacturing lines, the books for fall are showing substantial gains. The retail business is only fair, but is practically as heavy as had been expected. Among the wholesalers and jobbers there is very little doing in the way of new orders, and the reorder business is not of great importance. Many inquiries, however, are coming in, and the general sentiment is that the fall business will be up to the standards reached before the period of depression began. The crop situation is generally satisfactory. The cold, rainy weather throughout some sections of the West during the past week was unfavorable to growing crops, but the effect is more a matter of delay than of positive injury. Cereals have practically held their own, and there is a distinct improvement in the condition of the cotton crop. It is in the industrial lines, however, that the greatest improvement is to be noted. In numerous places the cuts that were made in wages earlier in the year have been restored, and in almost every section more help is being employed. Steel conditions continue to be very propitious. The United States Steel Corporation is now shipping to customers at the rate of a little more than 9,000,000 tons of finished products for the year. The actual shipments in 1907 were below 10,500,000 tons, and this shows that operations at the present time are almost normal. The manufacturing companies are making no effort to force up prices, and this policy is certain to result in liberal building and in expansion. One of the chief features of interest in this line is the heavy specifications which are now coming forward from the railroads for cars and other equipment. Fair sized orders for rolling stock were placed last week, and a very heavy volume is expected at an early date. Purchases of steel rails are better than they have been, and it is understood that during the past week 36,000 tons were taken by domestic consumers, and orders for 49,000 tons were entered for shipment to Argentina. Business failures for the week ended June 17, as reported by *Bradstreet's*, were 213, against 197 the previous week, 254 in 1908, 165 in 1907, 173 in 1906 and 157 in 1905.

THE COPPER MARKET.

There has been a sharp reaction in prices of copper during the past week both in this country and in Europe. The disclosure that since the middle of May there has been an apparent accumulation of 25,000,000 lb. in standard warehouses in Europe has revealed the fact that recent heavy exports from the United States have not been going into consumptive channels as heavily as has been claimed by the selling agencies. This has caused a material reduction abroad and in consequence a recession in this market. The break in the London price for the week has been a little less than £2 per ton, but since the high point on June 7 the recession has been £3 5s. Domestic producers did all in their power to resist the decline in this market, but were finally forced to accept bids below the quoted figures, and eventually the official quotations had to be marked down. As is usually the case in the home market, the recession in price was attended by the withdrawal from the market of domestic consumers. It has been well known for years that our consumers prefer to buy on an advancing rather than a declining market. It is said that sales of electrolytic were made in this market within the past few days at less than 13 cents although the official quotation has not been below that mark. One interesting feature in the local copper market during the past week was the report of the committee appointed by Governor Hughes to investigate New York exchanges. This committee spoke very plainly with regard to the Metal Exchange and expressed the opinion that it served no good purpose either for the metal trade or the public. The report showed that the quotations were arbitrarily fixed by a committee and did not represent actual transactions. The fact that these quotations were deceptive has been frequently referred to in these columns. In speaking of the exchange the report says: "In spite of the apparent activity of dealings in this organization in published market reports, there are no actual sales on the floor of the Metal Exchange, and we are assured that there has been none for several years. Prices are, however, manipulated up and down by a quotation committee of three, chosen annually, who represent the great metal selling agencies as their interest may appear, affording facilities for fixing prices on large contracts, mainly for the profit of a small clique, embracing, however, some of the largest interests in the metal trade. These practices result in deceiving buyers and sellers. The making and publishing of quotations for commodities or securities by groups of men calling themselves an exchange, or by any other similar title, whether incorporated or not, should be prohibited by law, where such quotations do not fairly and truthfully represent any bona fide transactions on such exchanges. Under present conditions, we are of the opinion that the Metal Exchange does actual harm to producers and consumers, and that its charter should be repealed." The actual production of copper continues at a record rate and the accumulation in second hands must be as great in this country as it is in Europe. Imports continue heavy, and since the first of June have been 4420 tons of copper, 785 tons of matte and 22,560 tons of ore. Actual exports, mostly representing sales made several weeks ago, are also large. Since the first of the month up to and including June 21 the exports have been 22,242 tons. Quotations on the Metal Exchange June 21 were:

Lake	13⅜ @ 13⅝
Electrolytic	13 @ 13¼
Casting	12¾ @ 13

The London prices June 21 were as follows:

	£ s d	£ s d
Standard copper, spot	58 7 6	58 13 9
Standard copper, futures	59 5 0	59 12 6
Market	Easy	Firm.
Sales of spot		1,400 tons
Sales of futures		1,600 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	....	....
Lake	14.55	12.55
Electrolytic	14.25	12.12½
Casting	14.12½	12.00
London, spot	£64 2 6	£54 12 6
London, futures	64 17 6	55 10 0
London, best selected	67 15 0	59 0 0

LIBERAL ORDERS FOR STEAM TURBINES.—Since the beginning of June the orders for steam turbine equipments which have been received by the Westinghouse Machine Company at its shops in East Pittsburg have been practically as numerous as during the busy times of 1907. All indications point to a great improvement in business for the summer months. Among these orders are one for a 1500-hp steam turbine and condenser from the Stark Electric Railway Company, of Alliance, Ohio; a 500-hp turbine from the Goodyear Lumber Company, of Tomah, Wis.; a 3000-hp turbine from the Nichols Copper Company, of Laurel Hill, L. I.; a 1500-hp low pressure turbine from the Utah Light & Railway Company, of Salt Lake City; a 5000-hp turbine from the Rochester, Syracuse & Eastern Railway Company, of Lyons, N. Y.; a 500-hp turbine from the Red Oak Electric Company, of Red Oak, Iowa; a 5000-hp turbine and Le Blanc condenser from the Narragansett Electric Light & Power Company, of Narragansett, R. I., and one for an 1800-hp turbine from the West Virginia Pulp & Paper Company, of Covington, Va.

DUNCAN ELECTRIC MANUFACTURING COMPANY ADDS TO ITS PLANT.—Plans have been completed for an extension of the Duncan Manufacturing Company's plant at Lafayette, Ind., consisting of a five-story building 113 ft. x 130 ft. The new factory will be fitted for turning out Duncan meters and new lines to be added, while the present plant will be used in the manufacture of Duncan transformers, which are now made in rented shops. The Duncan company has steadily employed from 100 to 150 men since 1901 with no shutdown, and when the new factory is completed 225 to 250 men will be on its pay roll.

LIGHTING CARBON IMPORTERS CONTINUE HOPEFUL.—Although the Senate has adopted the Smoot amendment, fixing the proposed tariff on lighting carbons at 65 cents per 100 ft., the importers in this city are inclined to believe that there will be a modification of this rate when the tariff bill gets into conference. The fact that the carbon schedule, which is such a small part of the general tariff bill, attracted enough attention to require almost five hours' discussion, shows that the matter has been to some extent studied, and is being considered by the members of Congress. Speaking of this matter, one of the largest importers of carbons in this country had this to say: "Although it seems on the face that the importers have not been successful in their endeavor to secure a cheaper rate on lighting carbons, we feel yet that we have won a distinct victory in bringing the matter to the attention of the Senators, and we feel that when the bill goes into conference a compromise will be made that will give us a better chance to do business. I have received assurances from authoritative powers in Washington that our interests are in good shape, and intimating that when the final schedule is adopted, we will be in a position to continue in business and at a profit. The main difficulty we encountered from the start was in attracting attention to a matter which was relatively so insignificant. Very few people were interested in carbons, or knew anything about them, but we have succeeded in having the matter thoroughly threshed out, and we have interested a number of prominent Senators and Represenatives in the situation. We feel, therefore, that it will bear fruit when the final consideration of the bill comes up."

NO NEW HAVEN ELECTRICAL PLANS SETTLED.—In speaking of the New York, New Haven & Hartford electrification plans, George MacCullough Miller, a director in the company, had this to say: "Although the New Haven will undoubtedly electrify the road from Stamford to New Haven sometime in the future, only preliminary estimates have as yet been made and the directors have called upon Vice-President McHenry and the chief engineer for revised estimates. No actual definite decision in the matter has been reached. This is only one of many problems that are under consideration; among others, the projected New York, Westchester & Boston line to handle freight traffic on easy grades from New Rochelle to Danbury. We have ordered an electric freight locomotive and are building a mile of track on which to give it a trial, to see whether electrical freight locomotives are more economical and serviceable than steam." The cost of electrification already completed, from Woodlawn Junction to Stamford, four tracks of approximately 22 miles each, has amounted to about $5,000,000. Work is under way on the six-track line from the Harlem River to New Rochelle, a distance of about 11⅛ miles. The cost of electrifying this line as well as the yards at the Harlem River, about 160 miles of track in all, has been estimated at approximately $13,000,000.

SAFETY CAR HEATING & LIGHTING COMPANY.—An official of the Safety Car Heating & Lighting Comapny states that the improvement in the equipment situation has been greater within the past two months than in any similar period in the history of the industry. In most lines the demand is as good at the present time as it was in 1907. The company now has in operation 70 Pintsch light gas plants in various parts of the country and the increase in this branch of the company's business averages about 10 per cent per year. The company is rapidly developing its system of electric lighting by means of an axle driven dynamo together with the lamp voltage regulator. Among the recent orders which the company has received for equipping cars with this system are: Chicago, Rock Island & Pacific, 157; Southern Railway, 125; New York Central, 25; Lehigh Valley, 15, and Pullman Company, 10. The use of electricity for car lighting is growing in popularity with the big companies.

PROPOSED ELECTRICAL PLANT IN FAR EAST.—An American consul in the Far East reports that an electric light and power plant will be constructed in his district within two years, to cost about $500,000. No machinery or material has yet been purchased, but an agent of the company will leave shortly to consider the purchase of the necessary equipment. The plant, while it is designed to furnish electric light for a municipality, will later furnish the energy for an electric street car line. A copy of the complete report can be obtained by interested firms from the Bureau of Manufactures, Washington. The file number of the record is 3535.

SIX THOUSAND-HP NORTH CAROLINA WATER POWER IN THE MARKET.—A. H. Richardson, of Ansonville, N. C., writes that engineers have just investigated a water power owned by him in the Piedmont region of North Carolina, and report that 6000 hp can be developed. The owner believes that all of this power can be disposed of within 30 miles of the generating point, as there are more than 60 cotton mills within that radius. Mr. Richardson wishes to open negotiations with any parties interested in such a development with a view to financing or selling the property.

ELECTRIC RAILWAY EXTENSION IN CHAUTAUQUA COUNTY, N. Y.—After three years' delay all difficulties in the way of the extension of the electric railway from Westfield, N. Y., to Barcelona Harbor on Lake Erie have been removed, and cars are now running to the lake, or will be very soon. The electric line is owned by the Chautauqua Traction Company, and the delay was caused by negotiations with the Lake Shore steam railroad over a bridge crossing. Finally the Business Men's Association of Westfield took a hand in the affiair, and an agreement was reached.

ELECTRICAL CONSTRUCTION.—Among the items printed under Construction Notes in the present issue are announcements of proposed new plants or considerable extensions of present plants at Fairfield, Iowa; Pawtucket, R. I.; Oakland, Cal.; Johnstown, Pa.; Milwaukee, Wis.; Philadelphia, Pa.; McGregor, Iowa; Mason City, Iowa; Vancouver, B. C., Can.; Nevada City, Cal.; Yreka, Cal.; Siloam Springs, Ark.; Battle Mountain, Nev.

FREIGHT LOCOMOTIVES FOR THE NEW YORK, NEW HAVEN & HARTFORD RAILROAD.—The New York, New Haven & Hartford Railroad has placed an order with the Westinghouse Electric & Manufacturing Company for two electric freight locomotives to be employed on its main line. One of these locomotives is to be equipped with side rods and the other is to be of the geared type.

ELECTRIC AND GAS FIXTURE TRADE ASSOCIATION.—A movement is under way to organize a national association to represent the interests of the electric and gas fixture trade. A meeting for this purpose will, it is stated, be held within the next few months. John F. Byrnes, 324 Dearborn Street, Chicago, is closely identified with the movement.

CATALOGS WANTED.—The Wind-Power Electric Company, Madison, Wis., recently incorporated to carry on the business of installing electric lighting plants in farms, dairies and suburban homes, desires to receive catalogs of electrical apparatus, storage batteries, wiring material and electrical supplies in general.

Financial Intelligence.

THE WEEK IN WALL STREET.

The past week in the New York stock market has been one of sagging prices but fairly active trading. This condition was not unexpected after the rather remarkable advances which occurred the latter part of May. When the stock market is in the hands of professional manipulators to the extent that has existed for the past year, it is but reasonable to expect liquidation and profit taking as soon as any considerable advance is recorded. The present reaction was expected, and it is claimed by many close observers in the street that it was not as extensive as was anticipated. However this may be, there have been general recessions in prices of all active issues of from three to seven points, and there has been a disposition to sell stocks whenever prices appeared to remain firm, or whenever there appeared to be any buying interest in the market. It is hardly proper to say that there has been developed any distinct bear element, although no doubt a number of professional dealers, after unloading at the top, went short for quick turns. It is always the outsider who is the last to perceive the tendency of the market, and who is the first to become alarmed over any reaction. The news developments of the week were very few, and were not particularly important. A great deal was made over the reports from Paris of the hitch in the proposed listing of Steel common on the Bourse. This, as a matter of fact, was a very unimportant event. It was only proposed to list a limited number of shares as a start, and the fact that this listing was denied can have no effect on the general market for Steel common. The plan, however, to place the stock upon the Paris market was largely used to help along the advance movement,

and was no doubt more responsible for pushing the price of the stock up to new high records than the actual prosperity of the steel company. Conditions as a whole are satisfactory, and favorable to a continued healthy market. There has as yet been no check in the public eagerness to take good bonds, whether they be railroads or industrials. This in itself assures successful financing of all legitimate enterprises. Call money on June 21 was 1½ @ 1⅞ per cent, while 90-day loans were 2½ @ 2¾ per cent. The quotations in the table are those of the close June 21.

NEW YORK.

	June 14.	June 21.	Shares sold.		June 14.	June 21.	Shares sold.
All.-Ch.	16	15¼	3,770	Int.-Met, pfd..	46⅝	44⅜	89,680
All-Ch., pfd..	54	51⅞*	13,950	Mackay Cos..	81½	79½	1,500
Amal. Cop...	85⅞	78⅜	184,045	M'c'ky Cs., p.	75⅛	74*	750
Am. D. T....	29*	29*	——	Man. Elev....	144	143	510
Am. Loc.....	60½	58⅛	12,800	Met. St. Ry..	29*	27	400
Am. Loc.. pfd.	117⅜*	117¾*	505	N.Y.&N.J. Tel.	124	129	800
Am. Tel.&Cbl.	80*	80*	——	Steel, com....	69½	64¼	885,756
Am. T. & T..	142½	140⅛	24,517	Steel, pfd....	125¾	121	44,921
B. R. T.....	80¼	77¼	28,925	W. U. T.....	75	72⅝	3,850
Gen. Elec....	163½	160	8,700	West'h, com..	86¾	83	8,860
Int.-Met. com..	17	15¾	53,550	West'h, pfd...	122*	121*	100

PHILADELPHIA.

	June 14.	June 21.	Shares sold.		June 14.	June 21.	Shares sold.
Am. Rys.....	45¾	45¾*	——	Phila. Elec...	11⅞	11¾*	——
Elec. Co. of A.	12½	12⅜*	——	Phila. R. T...	27⅞	28⅜	——
Elec. St. B'ty.	54½	53½	——	Phila. Trac...	91	91*	——
E. S. B'ty. pfd.	49*	49*	——	Union Trac...	52⅞	52	——

CHICAGO.

	June 14.	June 21.	Shares sold.		June 14.	June 21.	Shares sold.
Chi. City Ry..	180*	180*	——	Chi. Tel. Co..	134	132½*	——
Chi. Rs., Ser.1.	107*	107*	——	Met. El., com.	19*	19*	——
Chi. Rs., Ser.2.	36½*	36½*	——	Met. El., pfd	54*	54*	——
Com. Edison..	119½	118	——	Nat'l Carbon..	93½	93*	——
Chi. Sub'ws..	25*	24¼*	——	Nat'l C., pfd..	118	118*	——

BOSTON.

	June 14.	June 21.	Shares sold.		June 14.	June 21.	Shares sold.
Am. T. & T...	142⅜	140¾	——	Mex. Tel.....	3	2¾*	——
Cum. Tel.....	136*	133½	——	Mex. Tel., pfd.	6⅜	6*	——
Edison. E. Ill..	249	249	——	N. E. Tel....	133	132	——
Gen. Elec....	163½	160	——	W. T. & T....	11½*	10*	——
Mass. E. Ry..	12*	12	——	W. T. & T., p.	87	87*	——
Mass E. R., p.	67¼	67½	——				

*Last price quoted.
Shares sold are for week June 14 to June 19.

DIVIDENDS.

American Cities Railway & Light Company, preferred, quarterly, 1½ per cent; common, 1 per cent, both payable July 1.

American Telegraph & Telephone Company, quarterly, 2 per cent, payable July 15.

Bell Telephone Company, of Canada, semi-annual, 13 per cent, payable July 1.

Cumberland Telephone & Telegraph Company, quarterly, 2 per cent, payable July 1.

Electric Storage Battery Company, quarterly, ¾ per cent, both common and preferred, payable July 1.

Germantown Passenger Railway, Philadelphia, quarterly 2.62½ per cent, payable July 8.

Michigan Light Company, quarterly, preferred, 1½ per cent; common, 1 per cent, both payable July 1.

Philadelphia Company, quarterly, common, 1½ per cent, payable Aug. 2.

Sao Paulo (Brazil) Tramway, Light & Power Company, quarterly, 2½ per cent, payable July 1.

Shawinigan (Que.) Water & Power Company, quarterly, 1 per cent, payable July 1.

Tri-City Railway & Light Company, Davenport, Iowa, preferred, quarterly, 1½ per cent.

United Traction Company, Philadelphia, semi-annual, 2½ per cent, payable July 20.

Westinghouse Air Brake Company, quarterly, 2½ per cent, payable July 10.

Wilkes-Barre Gas & Electric Company, 1 per cent, payable July 1.

NEW ORLEANS RAILWAY & LIGHT REFINANCING.—The directors of the New Orleans Railway & Light Company have issued a statement in the form of a letter to the stockholders, setting forth their reasons for the issuance of a large new bond issue of $50,000,000, for which approval of which issue the stockholders have been called to meet. The resolution of the directors asks the approval of the authorized issue of $50,000,000, 40-year, first and refunding 5 per cent mortgage bonds, of which $30,000,000 are to be set aside to retire existing obligations, and $20,000,000 are to be available for extensions. It is the opinion of the board that if such an issue is approved, enough bonds be issued and sold to take and pay the $1,266,000, 6 per cent gold debenture notes due on Nov. 1, 1909, if in the judgment of the board it is deemed advisable to do so, and that all bonds to be issued further for the purposes of extensions, improvements shall only be issued for 75 per cent of the cost of such improvements. The plan is to limit as far as is practicable the issuance of additional bonds on the company's property. It is also set forth that the rapid growth of the city, and extensive paving to be done, in which the company will have to make considerable expenditures, and the contemplated improvements of the company, could hardly be met by the net earnings wholly, should they be sufficient, and at the same time allow the company to meet its franchise obligations, and as much of the work, including paving, will be permanent, the directors do not believe that the shareholders of the next few years should be burdened with the entire expense, as stockholders of 10 to 30 years' record will be benefited thereby.

HUDSON RIVER WATER POWER COMPANIES.—Counsel for the several bondholders' committees of the eight Hudson River Water Power companies which went down in the failure of E. H. Gay & Company, of Boston, have agreed to formulate jointly a petition asking for a foreclosure sale of the property. The present status of the companies is that injunctions have been issued preventing various trust companies from foreclosure on the mortgages which they hold. Counsel for the various bondholders' committees have had a hearing before Judge Ray, of the United States District Court in New York, preliminary to asking for the foreclosure. The judge expressed the opinion that before making any formal application counsel should get together and agree upon some plan in regard to the proceeding. He said that an appraiser had gone over the properties and placed a value of between $9,000,000 and $10,000,000 on them, but that owing to the different interests represented it seemed practically certain that there would be a conflict if sales of the properties individually were ordered. Charles H. Tyler, representing the Boston bondholders' committee, has announced that plans for the reorganization of the properties were being prepared and that all eight of the companies would be included in these plans.

BUTTE ELECTRIC BONDS OFFERED.—Lee, Higginson & Company are offering to the public $1,650,000 of first mortgage 5 per cent bonds of the Butte Electric & Power Company. The offering price is 98 and interest, which yields the investor a trifle over 5 1-10 per cent. The net income of the Butte company after paying all fixed charges in 1908 was $390,700. It is claimed that the future of the company is very bright, and that the high cost of steam coal in the territory in which the company operates makes it one of the best markets in the world for electric power. The company has recently purchased a half interest in the Great Falls Water Power & Townsite Company, which is now developing 35,760 hp at its hydro-electric plants and contemplates improvements which, it is claimed, will add 57,000 hp.

PENNSYLVANIA LIGHT COMPANY SOLD.—The entire capital stock of the Mifflin County Gas & Electric Company has been purchased by the Utilities Company of Philadelphia. The same purchasers bought a month ago the stock of the Lewiston & Reedville Electric Railway Company. It is proposed to build a trolley line 32 miles long between Bellfonte and Lewistown. It is promised that in a short time there will be through trolley service between Harrisburg and Altoona.

BALTIMORE ELECTRIC COMPANY'S BONDS SOLD.—The Consolidated Gas, Electric Light & Power Company, of Baltimore, has sold to Drexel & Company, of Philadelphia, and E. H. Rollins & Sons, of Boston, $3,584,500 general mortgage 4½ per cent bonds of the Consolidated Gas Company, a subsidiary. This makes $6,553,500 of the authorized issue of $15,000,000 that are now outstanding.

CHICAGO RAILWAYS BONDS SOLD.—N. W. Harris & Company and the National City Bank, of New York, have purchased $5,000,000 of Chicago Railways Company's first mortgage 5 per cent bonds, the proceeds of which will be used for rehabilitation and extensions. The bankers will probably offer the bonds to the public within a few days.

KINLOCH LONG DISTANCE TELEPHONE INCREASES STOCK.—The capital stock of the Kinloch Long Distance Telephone Company, of St. Louis, Mo., has been increased from $3,000,000 to $5,000,000. The company has 18 exchanges and 30,000 phones. It serves a population of 3,000,000 people.

BERGMANN ELECTRICITY WORKS COMPANY.—This company in its report to stockholders says that the works have been fully employed during 1908, the invoiced goods having amounted to $5,757,500, $500,000 in excess of 1907, which in turn exhibited an advance of $1,250,000 over 1906. Owing to keener competition, the sale prices realized were substantially less than in the preceding year, but it was possible to counteract these conditions by the purchase of raw materials on favorable terms and by the production in the company's own metal works of semi-finished articles at a lower rate and independently of other firms. The accounts indicate the following figures for the past two years:

	1908.	1907.
Capital paid up	$4,152,500	$3,500,000
Gross profits	2,068,950	1,781,250
Depreciation provision	328,990	338,050
Net profits	792,000	689,950
Dividend	630,000	540,000
Dividend, per cent	18	18

During 1908 the share capital was raised by $1,750,000 to $5,250,000, but the time has not yet arrived for the payment of the remaining instalments on the former. In addition, an issue of $2,500,000 in bonds is in contemplation, so as to provide funds for dealing with large transactions in a similar manner to that projected by the recently created electrical banks. The report gives particulars of the work accomplished by the different departments, and states that the new cable factory was started at the beginning of 1909, although only minimum profits are obtainable in view of the dissolution of the cable syndicate. The various departments employed 5000 workers at the end of 1908, as against 4,000 at the close of 1907. It may be added that recently the Bergmann Company made arrangements and favorable terms for itself for the reconsideration of the cable combination.

LACLEDE GAS LIGHT COMPANY SALE.—Details of the sale of the ownership of the Laclede Gas Light Company, of St. Louis, to the banking firms which represent a syndicate of St. Louis capitalists, have been given out. The investors include Adolphus and August A. Busch, W. K. Bixby, Thomas H. McKittrick, Charles H. Huttig, L. E. Dennig, E. H. Everett and G. H. Walker. These parties bought 74,000 out of the 85,000 shares of the company for a cash consideration of $7,480,000, or $101.08 per share. The best offer, it is said, that Emerson McMillan, chairman of the board of directors of the American Light & Traction Company, would make for this stock was on the basis of $93.50 per share. The Laclede Gas Light Company was incorporated in 1857, and had a perpetual charter from the State of Missouri, and perpetual right to use the streets of St. Louis for pipes and mains, and for "any appliances for conducting a substitute for gas." Its gross capitalization is $30,100,000, consisting of $19,100,000 of bonds and $11,000,000 in stock. Of this, $8,500,000 is common stock and $2,500,000 preferred. It controls the St. Louis County Gas Company, with a capital of $300,000, and is authorized to supply electricity to St. Louis. The reason for the sale, as explained by an official of the North American company, was the question whether or not the company could legally own the Laclede company and the Union Electric Light & Power Company. The attorneys for the company were of the opinion that the charter of one of the minor companies might be jeopardized by the joint ownership, and so the sale was decided upon as a way out of the difficulty. Officials of the North American Company in this city deny that there was any popular opposition sufficiently strong to cause the sale.

ELECTRIC VEHICLE REORGANIZATION.—Details of the plan for the reorganization of the Electric Vehicle Company, the approval of which was noted in the last issue, have now been made public. The plan contemplates the formation of a new company, to be known as the Columbia Motor Company, with a capital stock of $3,000,0000, of which $2,000,000 will be 6 per cent non-cumulative preferred stock and $1,000,000 common stock. The company will be organized under the laws of Connecticut. The old company has now outstanding $814,500 of 8 per cent non-cumulative preferred stock and $10,450,000 common stock. The bondholders of the present company will receive for each $1,000 par value of bonds preferred stock to the amount of $620 par value in the new company. The present preferred stockholders will receive one share of common stock for each 20 shares of preferred stock which they now hold. The present holders of common stock, upon payment of $1 for each share of such stock, will receive one share of common stock in the new company for each 20 shares which they now hold. The unsecured creditors will receive all dividends which may be declared out of the proceeds and effects of the company, or will receive preferred stock on the basis of one share for each $100 of dividends. The creditors secured in whole or in part by pledges of bonds will receive preferred stock of the par value of $620 for each bond of $1,000. The order of the court authorizes the receivers to sell the property, except the cash in bank, to the committee of which Herbert Lord is chairman for $430,000. The receivers are to reserve $150,000 for distribution among the creditors.

METROPOLITAN STREET RAILWAY REORGANIZATION.—No definite plan for the reorganization of the Metropolitan Street Railway system has yet been given out, but it is known that several are being formulated. During the past week the committee representing the holders of the 4 per cent refunding mortgage bonds of the company has issued a circular which says that, after a careful examination, the committee has found that under existing conditions the company is not able to earn the interest charges on either the 4 or 5 per cent bonds. The committee gives two reasons for this condition; one is that the transfer system imposed by the public authorities has reduced the average fare from 5 cents to practically 3 cents, while under existing laws, based on the theory that the property produces large profits, the taxing officials maintain that more than 35 per cent, and even 40 per cent, of the net earnings must be paid by way of special franchise and other public charges. This condition, the committee claims, practically amounts to confiscation. The committee further says that unless legislative relief can be had it would probably be the wisest course to foreclose and sell, even though that action would disrupt the system. The circular is signed by Edwin S. Marston, chairman, John W. Castles, Dumont Clarke, Robert Y. Hepden and Otto H. Kahn. There seems to be no doubt that the Interborough-Metropolitan Company intends to protect its interests in the surface lines, even though such protection will involve an assessment amounting to $10,000,000 on the shares which it now holds.

CHESTER COUNTY (PA.) ELECTRIC COMPANY.—A circular has been sent to the board of directors of the Chester County (Pa.) Electric Company by R. B. Rhodes, the manager, which urgently sets forth the necessity for reorganization of the concern, and which declares that the present condition is serious. The circular says that at a foreclosure sale everything the company owns or controls would not bring $50,000, although it would take that much to replace it. It points out the fact that there are outstanding $190,000 in first mortgage bonds, of which $165,000 have been sold, and $24,000 are in the treasury. There are also said to be outstanding $27,000 in unpaid notes and $4,000 in other bills. The capital stock issued amounts to $300,000. The circular also refers to court investigations which have been begun to look into the manner in which the company was financed.

HARRIMAN BUYING POWER PROPERTIES.—News is received from California that E. H. Harriman has bought the electric power and electric railroad properties in and around the town of Fresno, Cal. This is considered to be a part of a general plan adopted some time ago by Mr. Harriman for acquiring control of power rights and electric railways in California. The consideration paid for the recent purchase was in the neighborhood of $2,000,000, and payment was made partly in cash and partly in Southern Pacific Railroad Company's 4 per cent bonds. One of the properties purchased was the plant of the San Joaquin Light & Power Company near Fresno, and another being the Fresno Traction Company, with about 22 miles of road.

ASK STATEMENT FROM CONEY ISLAND RAILROAD.—The Public Service Commission has held up the application made by the Coney Island & Brooklyn Railroad Company for permission to issue $372,000 additional bonds, until a statement is made by the company as to what was done with the proceeds of the $900,000 new stock which was authorized in May, 1908. This new stock was authorized for improvements, and the new issue is now asked for the purpose of renewing the road bed and rails on about eight miles of the line.

MORE INTERBOROUGH RAPID TRANSIT BONDS.—The Interborough Rapid Transit Company has made an application to the Public Service Commission for permission to issue $10,000,000 of new 5 per cent bonds to take up a like amount of 5 per cent notes which fall due in March, 1910. These bonds are a portion of the $55,000,000 issue which has been authorized by the stockholders.

GENERAL NEWS

Construction News.

DOTHAN, ALA.—D. G. Zeigler, of Zeigler & Company, of Jacksonville, Fla., has submitted a proposition to the City Council to supply electricity in Dothan. It is proposed to utilize the water power of Abbey Creek, in Heney County, 22 miles from Dothan, and develop 4300 hp to furnish electricity in Dothan, Headland, Abbeville, Eufala and other towns within a radius of 60 miles. It is said that a site has been secured for the plant and if satisfactory arrangements can be made with the city work will commence on the project immediately.

LITTLE ROCK, ARK.—A permit has been issued by the Department of Public Works for the erection of a power plant at the Union Station. The plant will furnish light and heat for the depot and will cost about $60,000.

PARAGOULD, ARK.—The Marmaduke Telephone Company has been granted a 25-year franchise to construct and operate a telephone system in Paragould.

SILOAM SPRINGS, ARK.—Plans are being made for the extensions to the municipal electric light plant and water works system, which will involve an expenditure of about $30,000. W. W. H. Davey is secretary of water works improvement district.

FRESNO, CAL.—The contract for the construction of the proposed electric railway of the Fresno, Hanford & Summit Lake Interurban Railway Company from Fresno to Hanford, has been awarded to the Franklin Construction Company. F. S. Granger is vice-president and general manager.

LOS ANGELES, CAL.—Plans are being prepared by the aqueduct commission for the erection of hydro-electric plants along the aqueduct way in connection with the Ownes River water project for the city. It is said that the commission will apply to the City Council for an appropriation from the general fund to cover the cost of preparing plans for the power development and inspection of hydro-electric machinery in connection with the project.

LOS GATOS, CAL.—The Los Gatos Ice, Gas & Electric Company has applied to the Board of Supervisors of Santa Clara County for a franchise to erect transmission lines over the roads, streets and highways of the county for the distribution of electricity for lamps and motors. The Supervisors have agreed to grant such a franchise, bids for which will be received until July 12 at the office of the Supervisors, San Jose, Cal. Henry A. Pfister is clerk of the board.

NATIONAL CITY, CAL.—The City Trustees are considering the question of improving the street lighting system in this city.

NEVADA CITY, CAL.—Plans are being considered for the construction of a large electric power plant to furnish electricity for the mines in Sierra County. C. York and W. A. Lotspeich have filed a notice of appropriation of 15,000 cu. in. water rights in the south fork of the North Yuba River, between Downieville and Sierra City. A large dam is being erected two miles above Downieville. A site for a power house has been selected on Durgan Flat. The water will be carried in a pipe a distance of 9000 ft., where a sufficient fall will be secured to generate 4000 hp. Two units of 2000 hp each will be installed. It is said that the company will soon commence work on the construction of a transmission line to Allegheny and Forest City. The cost of the plant is estimated at $250,000.

OAKLAND, CAL.—The Central Oakland Light & Power Company has applied to the Board of Public Works for a permit to construct a power house on First Street.

SAN DIEGO, CAL.—The Grossmont Park Company, recently incorporated with a capital stock of $50,000, proposes to take over part of the lands owned by Col. Fletcher and W. B. Gross, and will construct buildings, pipe lines and also generate electricity, etc. W. B. Gross, Col. E. Fletcher and others are interested in the project.

SANTA PAULA, CAL.—The Board of Trustees has decided to replace the present street lighting system with tungsten lamps and has authorized the president and secretary to enter into a contract with the Ventura County Power Company to install the new system immediately.

VENTURA, CAL.—Negotiations are under way to have the electric light and water service extended to the Beach tract this summer. J. A. Driffill is president of the Ventura County Power Company.

YREKA, CAL.—Surveys have been completed for the new transmission line of the Siskiyou Electric Light & Power Company from the Fall Creek power house as far as Sisson, and will be extended to Dunsmuir. The line will be about 55 miles in length and will furnish electricity to pump water for irrigation purposes. The company is building an addition to its Fall Creek power house to provide for another 1000-kw generator. The new transmission line will be operated at a potential of 40,000 volts.

COLORADO SPRINGS, COLO.—The Golden Cycle Mining Company has purchased the controlling interests in the Pike's Peak Fund and Central Fuel Companies. The Golden Cycle Mining Company proposes to construct a power plant near the Pike View mine, the initial cost of which is estimated at $200,000. The plant will furnish electricity to operate the Golden Cycle mill, which will utilize about 1500 hp. The Colorado Springs Electric Company now has the contract for furnishing power for the mill, which will expire next year. John T. Milliken, of St. Louis, Mo., controls the Golden Cycle Mining Company; Harvey McGarry, of Colorado Springs, is vice-president and manager.

DENVER, COL.—The power plant of the Denver Gas & Electric Company was damaged by a boiler explosion June 15, causing a loss of not less than $250,000. Electricity for operating the system is now supplied from the plant of the Central Colorado Company.

HARTFORD, CONN.—The House of Representatives has passed the bill amending the charter of the Northern Connecticut Light & Power Company permitting it to issue bonds to the amount of $350,000.

SOUTHINGTON, CONN.—The Legislature has granted an extension of time until July 1, 1911, to the Litchfield & Torrington Tramway Company in which to commence the construction of its proposed electric railway between Torrington and Lake Boston, 6 miles in length. T. H. McKenzie, secretary and treasurer, states that the company is planning to construct the railway this summer.

WILMINGTON, DEL.—The Board of Education has awarded the contract for furnishing electricity for lamps and motors to the Wilmington Light, Power & Telephone Company for a term of three years at the rate of 4 cents for lamps and 2¾ cents for motors.

FORT PIERCE, FLA.—The City Council has granted the St. Lucie Ice Company a franchise to construct an electric light and power plant.

JACKSON, FLA.—The City Council has adopted an ordinance under which the lighting committee of the Council is directed to enter into a 10-year contract with the Jackson Light & Railway Company on a basis of $87.50 per lamp per year under an all-night schedule, which is $26.40 less than the price of the present contract. The city now pays $114 for each arc lamp. It is expected that the company will refuse to accept the terms of the ordinance.

MACCLENNY, FLA.—A special election will soon be called to vote on the proposition to issue $5000 in bonds to light the streets of the town.

PENSACOLA, FLA.—Application has been made to the City Council by C. F. Dobson, C. C. Goodman and R. O. Hoffman for a franchise to construct an electric railway in this city.

QUINCY, FLA.—Preparations are being made to construct a new power house for the municipal electric light plant and to enlarge the water-works system.

ATLANTA, GA.—The City Council has granted a franchise to the Georgia Railway & Electric Company to construct a street railway on West Peachtree and Ponce De Leon Avenues.

BREMEN, GA.—At an election to be held June 26 the citizens will vote on the proposition to issue $8,000 in bonds for the construction of an electric light plant.

COLUMBUS, GA.—The Columbus Manufacturing Company is planning to build an addition to its plant, which will double the output of the mill. The cost of the work is estimated at $500,000. Electrical power is used to operate the mills which is furnished by the Columbus Power Company. F. B. Gordon is president.

UNION POINT, GA.—The Union Manufacturing Company, of Union Point, is reported to be in the market for 250, 200, 150 and 100-kw second-hand alternating generators.

CENTRALIA, ILL.—The Vincennes, Centralia & St. Louis Transit Company has filed a mortgage at Lawrenceville in favor of the Illinois Trust Company, of East St. Louis, Ill., for $2,500,000. The company proposes to construct an electric railway from St. Louis, Mo., to Vincennes, Ind. Burns & Company, Isabelle Building, Chicago, Ill., are said to be interested in the project.

CHARLESTON, ILL.—The Charleston, Westfield, Marshall & Terre Haute Electric Railway Company is planning to commence work soon on its proposed 12-mile electric railway.

CHATSWORTH, ILL.—The Chatsworth Electric Company has purchased the electric plant at Piper City, Ill., and has dismantled the same. Electrical service in Piper City is furnished from the Chatsworth plant. The company is contemplating establishing a day service, but has not yet fully decided upon it. L. A. Walter is secretary and treasurer.

CHICAGO, ILL.—The Northern Illinois Gas & Electric Company has filed a certificate of increase of capital stock from $2,500 to $600,000.

MOLINE, ILL.—The Tri-City & Northeastern Interurban Railway Company has applied to the Village Boards of Watertown, Rapids City, Hampton, Port Byron, Cordova and Albany for 20-year franchises, for its proposed electric railway, which will extend from Watertown to Albany.

MT. MORRIS, ILL.—The plant and holdings of the Mt. Morris Electric Company has been purchased by the Kane Brothers, of Mt. Morris. The new owners contemplate establishing a 24-hour service and furnishing electricity for motors.

MURPHYSBORO, ILL.—The capital stock of the Murphysboro Telephone Company has been increased from $10,000 to $50,000.

ROCHELLE, ILL.—The Chicago, DeKalb & Western Interurban Railway Company has applied to the City Council for a franchise in Rochelle for its proposed electric railway now under construction between DeKalb and Dixon.

CRAWFORDSVILLE, IND.—The Home Telephone Company is making extensive improvements and extensions which will include new equipment for exchange and considerable conduit work.

INDIANAPOLIS, IND.—The Board of Public Works will soon call for bids for electric wiring and conduits for the new city hall, for which bids were rejected when the general contract was let.

INDIANAPOLIS, IND.—W. S. Blatchley, State Geologist, is making a survey of Eel River through Putnam County with a view of utilizing the water power to generate electricity.

INDIANAPOLIS, IND.—The Board of Public Works has authorized the Indianapolis Light & Heat Company to commence work on the installation of the new lighting system in part of the business district. Under the plan proposed the Indianapolis Traction & Terminal Company will at its own expense replace the present street car poles with heavier ones. There will be 10 lamps to the square, for which the city will pay $74 each per year.

LIBERTY, IND.—The streets of this town will soon be lighted by electricity furnished from Richmond by Robert Asche, who has a 25-year contract for lighting the town at the rate of $48 per lamp per year.

MARTINSVILLE, IND.—The Citizens' Telephone Company is constructing a new exchange building in which considerable new equipment will be installed.

TERRE HAUTE, IND.—The New Long Distance Telephone Company, of Indianapolis, is installing an additional toll line. This company connects with the Citizens' Independent Telephone Company of this city and by means of this connection gives all other independents in this and adjoining counties an outlet for toll service.

TIPTON, IND.—The managers of the municipal electric light plant are considering the question of extending the electrical service to the farmers in the north and west sections of the towns.

DES MOINES, IA.—The City Council is considering an ordinance requiring all electric wires to be placed underground in the city.

EARLHAM, IA.—The Hawkeye Telephone Company is making improvements to its plant in Earlham. A new switchboard will be installed and the wires placed in cabies.

FAIRFIELD, IA.—H. C. Stevenson, superintendent of the Fairfield Gas & Electric Company, writes that the company is planning to make improvements and extensions to its plant, which will involve an expenditure of about $25,000, for which bids will soon be asked.

GRUNDY CENTER, IA.—The Grundy Center Electric Company is planning to change the street lighting system to series tungsten lamps and to install a small engine. J. B. Calderwood is owner and manager.

MASON CITY, IA.—Plans are being considered for utilizing the water power of Lime River, at Portland, and the Sheel Rock at Nora Springs, to be utilized to generate electricity to operate an electric interurban railway between Mason City and Rockford, Ia.

MASON CITY, IA.—The Mason City & Clear Lake Railway Company is planning to erect a new power plant, which will have an output of 3000 kw. The equipment will include two steam turbines rated at 1500 kw each. The present power plant at Emery will be discontinued when the new power station is completed.

McGREGOR, IA.—Preparations are being made by the McGregor Light & Power Company to increase the output of its plant. A new engine and dynamo will be installed.

STORM LAKE, IA.—The capital stock of the Northern Telephone Company has been increased to $20,000.

WILTON JUNCTION, IA.—Plans are being considered for the installation of a new 100-hp boiler in the municipal electric light plant. F. C. Wickes is secretary and manager.

WHITESBURG, KY.—Plans are being made for extensions and improvements to the system of the Whitesburg Telephone Company. James P. Lewis is manager.

ALEXANDER, LA.—J. P. Turregan, mayor, writes that no extensions are contemplated to the electric light plant and water works system at present.

DENTON, MD.—Arrangements are being made to wire the business houses and residences in Denton preparatory to installing electric lamps. The town is now lighted by acetylene gas. Henry C. Hawkins, formerly with the Consolidated Gas & Electric Company, of Baltimore, is manager of the new electric light plant.

DENTON, MD.—It is reported that Thomas F. Garey, Jr., of Baltimore, president of the Peninsular Light & Power Company, has sold his interest in the enterprise to Harvey L. Cooper and Albert G. Towers, who were associated with him in the project. They will proceed with the construction of the electric light plant at Garey's mill, on Chapel branch, three miles from Denton, which will supply electricity in Denton, Greensboro and Ridgely. The contract for the construction of the plant has been awarded to J. L. Livers, of Lancaster, Pa. It is expected to have the plant in operation within a year.

FEDERALSBURG, MD.—The Idlewild Electric Light Company has extended its transmission lines to Preston to furnish electrical service in that place.

ATTLEBORO, MASS.—Plans are being considered by the Frank Mossberg Company for the construction of a new plant to be equipped for electric drive. It is proposed to install a plant capable of developing 150 hp.

BOSTON, MASS.—Contracts have been awarded for furnishing central power plant equipment for three army posts as follows: For boilers to E. Keeler Company, of Williamsport, Pa., for $17,378; Simplex Electric Company, of Boston, Mass., for cable, at $54,997; engines to Buffalo Forge Company, of Buffalo, N. Y., for $9,027; Walker Electric Company, of New York, N. Y., for switchboard, $2,234, and for generators to the Western Electric Company, of New York, N. Y., for $6,659.

BOSTON, MASS.—Bids will be received by Guy C. Emerson, superintendent of streets, for lighting the streets and parks with small lamps, for a term of five years, which costs the city approximately $350,000 a year. At present there are 14,000 lamps lighted by gas or naphtha, while the contract calls for gas incandescent mantle lamps; bids will also be received for electric lamps. Under the new contract the service will be furnished by either gas or electricity. The naphtha lamps will be discarded.

BOSTON, MASS.—Negotiations have been completed whereby the Worcester & Blackstone Valley Street Railway Company will take over the property and holdings of the Bridge & Blackstone Valley Street Railway, and the Worcester & Southbridge Street Railway Company agrees to purchase the property and holdings of the Hartford & Worcester Company. The consolidation of the four railways under two heads are subject to the approval of the State Railroad Commission.

BOSTON, MASS.—The Boston, Lowell & Lawrence Electric Railroad Company has petitioned the State Railroad Commissioners for a certificate of authority to construct an electric railroad between Lowell and Lawrence and connecting both cities with Boston. It is proposed to construct the railway over private right of way with no grade crossings. Paul Butler, Spencer Borden, Jr., Butler Ames, Oakes Ames and John Burnett are directors.

FISKDALE, MASS.—Work has commenced on the street lighting system in Fiskdale by the Webster & Southbridge Electric Light Company, and it is expected to have the system in operation by Aug. 1. The town voted to have the lamps installed three years ago and appropriated $900 for that purpose, the company agreeing to furnish 72 incandescent lamps of 25 cp for one year for that amount and $1200 per year thereafter. It now agrees to furnish lamps of 40 cp for the same price and to have them in place by Aug. 1.

WESTFIELD, MASS.—Bids will be received at the office of the Westfield gas and electric light works until June 30, for both 500 and 750-kw units, comprising engine and dynamo, also switchboard, exciter and condenser. The engine may be either of the horizontal turbine or the cross compound type (reciprocating) type. William H. Ensign, William E. Atwater and Lewis C. Parker are selectmen.

DETROIT, MICH.—The contract for the construction of the conduit on Grand River Avenue, from Washington Avenue to Twelfth Street, was awarded to Charles B. Cole. The cost is estimated at $14,803.

GRAND RAPIDS, MICH.—The City Council has revoked the franchise of the Thornapple Electric Company to furnish electricity in Grand Rapids. The company is now in the hands of a receiver. The above action was taken by the Council for the purpose of protecting the city in the pending litigation into which the company has become involved, and because it has failed to live up to the terms of its franchise, under which it was to furnish electrical service by May 1, 1909. The city did not wish to have the franchise named as one of the assets of the company.

INTERNATIONAL FALLS, MINN.—A franchise has been granted to the American Suburbs Company, of Minneapolis, Minn., to construct an electric railway from Ranier to International Falls.

NEW ULM, MINN.—Clarence E. Poynter, of New Ulm, writes that he and his father own a controlling interest in a flour mill and light plant in a Texas town of about 1500 population which they would like to sell or exchange for an electric light plant or for a combined electric light and ice plant in a town of from 3000 to 6000 inhabitants. For further information address Clarence E. Poynter, P. O. Box 382, New Ulm, Minn.

ST. PAUL, MINN.—The question of raising the lower dam located a short distance above the Soldiers' Home is under consideration. The proposition includes raising the dam from 15 to 30 ft. at a cost of about $300,000. It is estimated that about 15,000 hp could be developed. The dam, which is partially completed, is being built by the United States Government to deepen the channel as far as the Washington Avenue Bridge. The proposition involves raising the extra money by the Twin Cities to pay for additional construction and utilize the power to generate electricity for municipal purposes.

MARSHALL, MO.—The plant and holdings of the Saline County Telephone Company have been purchased by the Missouri and Kansas Telephone Company. It is said that the plant will be extended and improved. E. T. Purcell is local manager.

LINCOLN, NEB.—The Lincoln Telephone & Telegraph Company has purchased the independent telephone systems at Beatrice and Wymore, together with considerable mileage of toll and rural telephone lines in

Gage County. The companies will operate under a separate name, but will be controlled by the Lincoln company.

SUTTON, NEB.—A special election has been called by the City Council to be held July 23 to vote on the proposition to issue $39,000 in bonds, the proceeds to be used to acquire the local electric light plant and for extensions to the water-works system. It is proposed to enlarge the electric light plant if taken over by the city.

VALENTINE, NEB.—The citizens have voted to issue bonds to the amount of $42,000 for the installation of an electric light plant and water-works system in Valentine.

BATTLE MOUNTAIN, NEV.—The Lander County Power & Light Company, recently organized, proposes to install a light and power plant in Battle Mountain. It is stated that the main purpose of the company is to furnish power to the Golconda Consolidated Mining Company, which is planning to install a plant at Galena. The Lander Company proposes to furnish electricity within a radius of 20 miles of Battle Mountain.

LAS VEGAS, NEV.—The Rio Virgin Telephone & Telegraph Company has been granted a franchise by the County Commissioners to construct a telephone line in Muddy Valley.

HOBOKEN, N. J.—The Common Council has adopted a resolution recommending an ordinance be adopted granting the Citizens' Light, Heat & Power Company a franchise, and also a resolution to defer the awarding of the contract for lighting the city indefinitely, but announced that it would continue to purchase electricity for street lamps until further notice from the Public Service Corporation at $80 per lamp per year. Up to the present time the city has paid at the rate of $100 per lamp per year. The company offered to furnish street arc lamps at $70 per lamp per year and to supply electricity to private consumers at 8 cents per kw-hour. It is expected that the new company will be formally awarded the contract at the next meeting of the Council.

IRVINGTON, STA., NEWARK, N. J.—The Town Council has decided to advertise for bids for the installation of a municipal electric light plant, the bids to be opened at the September meeting of the Council. It has also decided to advertise for proposals for furnishing electricity and gas for lighting the town on a one, three and five-year contract.

BROOKLYN, N. Y.—The South Flatbush Railroad Company has applied to the Public Service Commission for permission to issue $30,000 in capital stock and for a certificate of necessity. John C. Langan is president.

BROOKLYN, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, corner of Park Avenue and Fifty-ninth Street, New York, N. Y., until June 28, for furnishing and installing electric equipment for Girls' High School, on Nostrand Avenue, Borough of Brooklyn. Blank forms, plans and specifications may be obtained or seen at the office of the superintendent, and at the branch office, 131 Livingston Street, Borough of Brooklyn.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, corner of Park Avenue and Fifty-ninth Street, until June 28 for repairs, alterations and addition to the electric equipment in Public Schools 4, 27 and 36 Borough of Bronx. Plans and specifications may be obtained at the above office.

NEW YORK, N. Y.—The Third Avenue Railroad Company has applied to the Board of Estimate and Apportionment for a franchise to build a double-track electric railway from the intersection of Third Avenue and Fifty-seventh Street, Manhattan, along Fifty-seventh Street to Second Avenue to Sixtieth Street and across the Queensboro Bridge to Jackson Avenue, Long Island City.

NEW YORK, N. Y.—Bids will be received by John F. Ahearn, borough president, for furnishing material and labor required for extension of electric lighting equipment, electric light fixtures, ventilating system, furniture, etc., for the eighth and attic floors in the Hall of Records Building, in accordance with plans and specifications prepared by Horgan & Slattery, architects, 41 West Twenty-third Street, New York, where plans may be obtained with blank form of contract.

NEW YORK, N. Y.—Bids will be received by the Department of Public Charities, foot of East Twenty-sixth Street, New York, N. Y., until June 28 for furnishing and delivering two 250-hp internal furnace boilers for the power house at the Metropolitan Hospital, Blackwells Island, New York. Blank forms and further information may be obtained at the office of the supervising engineer of the department, foot of East Twenty-sixth Street, where plans and specifications may be seen. Robert W. Hebberd is commissioner.

HICKORY, N. C.—Following the reported opposition of the Thornton Light & Power Company to the entrance of the Southern Power Company into the town, an agreement has been made whereby the Thornton company will receive electricity from the Southern Power Company, which will be permitted to enter Hickory. The Thornton Light & Power Company, it is stated, will distribute electrical power furnished by the Southern Power Company.

LAURINBURG, N. C.—The promoters of the Waverly Cotton Mills, in Laurinburg, have decided to equip the new mill to be operated by electricity. A power plant is now being erected.

MARION, N. C.—Plans are being made by the Marion Light & Power Company to construct a tunnel 100 yards long and a 40-ft. stone dam to secure more power for its electric plant.

ROANOKE RAPIDS, N. C.—Samuel F. Patterson, of Roanoke Rapids, N. C., is interested in a project to erect a large gingham mill in Roanoke Rapids, which will be operated by electricity. The cost of the plant complete is estimated at $650,000. A company will be organized under the name of the Patterson Mills Company.

STATESVILLE, N. C.—The Iredell Telephone Company has bought a site on which it is proposed to erect a telephone exchange.

SHERWOOD, N. D.—The Sherwood Electric Company is contemplating extending its telephone line ten miles west from Barber.

CLEVELAND, OHIO.—The Cleveland Electric Illuminating Company has awarded the contract for the construction of an addition to its plant on Canal Road to John Gill & Sons.

DELAWARE, OHIO.—Bids will be received by the Board of Trustees of the Girls' Industrial Home, Delaware, Ohio, until July 16, for furnishing material for the construction and installation of steam and electrical machinery and equipment, changes and additions in steam heating, piping, trenching, conduits, etc., for the Girls' Industrial School at Rathbone, Ohio. Plans and specifications are on file at the office of Harold M. Bush, engineer-in-charge, Broad-Oak Building, Columbus, Ohio. Proposals must be made upon blank forms, which can be secured from the engineer. Separate proposals must be made for materials and labor, as required by law. T. F. Day is secretary of Board of Trustees.

CHEROKEE, OKLA.—Extensive improvements are being made to the system of the Pioneer Telephone Company, which will involve an expenditure of about $10,000.

CLINTON, OKLA.—Preparations are being made by the Deer Creek Telephone Company to extend its telephone line from Arapaho to Custer City, a distance of 14 miles.

KONAWA, OKLA.—The citizens have voted to issue $35,000 in water and light bonds.

SAYRE, OKLA.—The citizens have voted to issue $15,000 electric light bonds.

TULSA, OKLA.—The City Commissioners have granted the Oklahoma Traction Company a franchise to construct and operate its railway in this city. Tulsa will be the center of the system, which will connect with Sapulpa, Broken Arrow and other nearby towns.

COQUILLE, ORE.—The City Council has granted a new franchise to Frank Morse, owner of the local electric light plant. The old franchise, under which the plant has been operating, recently expired. A franchise was recently granted to Clark & Somers, but as yet they have done nothing toward the construction of a system.

HERMISTON, ORE.—Application has been made by the Rose City Electric Company, of Portland, Ore., for a franchise to install an electric light plant in this city. It is proposed to erect a plant at a cost of about $15,000.

MARSHFIELD, ORE.—J. M. Blake, who it is said represents Eastern capitalists, has applied to the City Council for a franchise to construct and operate an electric railway in Marshfield.

MILTON, ORE.—The citizens have voted to issue $15,000 in bonds for extensions to the municipal electric light plant and water-works system.

ST. HELENS, ORE.—The McCormick Company has applied to the City Council for a franchise to construct and operate an electric light plant. It is proposed to install a plant at a cost of about $12,000.

BEAVER, PA.—It is reported that work has commenced on the construction of the proposed electric railway between Woodlawn and Sheffield by the Woodlawn Electric Railway Company. J. A. Newell, of Newell, W. Va., is president.

HARRISBURG, PA.—The City Councils on June 7 awarded the contracts for electric lighting (contracts do not include street lighting) as follows: For lighting city offices, fire engine houses, pumping station and filtration plant to the Harrisburg Light, Heat & Power Company for 7 cents per kw-hour, and to the Paxtang Electric Company for lighting subways at 6½ cents per kw-hour. The Harrisburg company submitted a bid at 7 cents to light the subways; the Paxtang Electric Company bid only on the subways, owing to its inability to reach other points.

JOHNSTOWN, PA.—It is stated that the Johnstown & Gallitzin Railway Company will award contracts in August for equipment for its steam power plant to be located near St. Michaels, which will be equipped with two units of 750 kw each. One substation will be located at the main power station near South Fork, Pa., and an additional substation will be erected at each end of the railway. George Holman, of Johnstown, Pa., is general manager and engineer.

LEWISTOWN, PA.—The Utilities Company, of Philadelphia, has purchased the stock of the Mifflin County Gas & Electric Company. It is said that this company is controlled by practically the same parties that purchased the stock of the Lewistown & Reedsville Electric Railway Company about a month ago. Dodge & Day, of Philadelphia, Pa., are interested in the company.

PHILADELPHIA, PA.—Bids will be received until July 24 at the Bureau of Yards and Docks, Navy Department, Washington, D. C., for furnishing at the navy yard, Philadelphia, Pa., three vertical compound, condensing steam engines, with a normal rating of 700 hp each, to be direct connected to 500-kw General Electric direct-current generators. Also complete stairways and operating platforms for these engines and an oiling system with a capacity for six engines same as the above. The cost of the work is estimated at $61,800. Plans and specifications can be obtained on application to the bureau or to the commandant of the navy yard named. R. C. Hollyday is chief of bureau.

READING, PA.—The committee authorized by the Council to prepare specifications for street lighting has recommended that proposals be called for street lighting for five or ten years for 700 or more magnetite arc lamps and 500 or more tungsten lamps with an all-night and every-night service.

SCHUYLKILL HAVEN, PA.—The contract for installing a 200-hp boiler, 300-hp engine and generator at the municipal electric light plant has been awarded to Jeremiah Woodbury & Company, of Hazleton, Pa., for $10,020. George E. Runkle is secretary.

PAWTUCKET, R. I.—Plans have been prepared by Charles T. Main, mill architect and engineer, of Boston, Mass., for a power plant for the Royal Weaving Company, of Pawtucket, R. I. The plans call for the construction of a power house 98x64 ft. and boiler house 93x47 ft. and smoke-stack 175 ft. high. The equipment will include three 500-kw Allis-Chalmers steam turbine units and four 350-hp Babcock & Wilcox boilers.

COLUMBIA, S. C.—The Southern Power Company is planning to extend its transmission lines to Columbia and will apply to the City Council for a franchise to erect its wires in this city for the distribution of electricity.

GREENVILLE, S. C.—Preparations are being made by the management of the Monaghan Mills, Greenville, for equipping the mills for electric drive, although the change will not be made at present. The large Cooper-Corliss cross-compound engine now in operation will be held for use in emergencies after the new equipment is installed.

GREER, S. C.—Plans are being prepared for the erection of a print mill at Greer, which will be equipped with 10,000 spindles and 300 looms. The plant will be equipped to be operated by electricity.

NEWBERRY, S. C.—It is said that the Newberry Cotton Mills will soon commence work on the construction of another mill, which will be equipped with 10,000 spindles and 300 looms. Electricity generated by steam power will be the motive power. Contracts for machinery have not yet been awarded. Lockwood, Greene & Company, 93 Federal Street, Boston, Mass., are engineers.

SPARTANBURG, S. C.—The Beaumont Manufacturing Company is planning to erect an addition to its building and will add 16,000 spindles and 350 looms to its equipment. Contracts for machinery have been awarded. The mill is operated by electricity.

MILBANK, S. D.—Plans are being considered for the installation of an electric lighting system in Milbank.

BELLEVILLE, TEX.—The First National Bank is reported to be interested in a project to establish an electric light and ice plant in Belleville.

DALLAS, TEX.—Arrangements are being made by the Dallas Independent Telephone Company for the installation of a telephone system in Dallas, which will involve an expenditure of $1,200,000. The contract for the construction of the entire plant has been awarded to the Jones & Winter Company, of Chicago, Ill.

TRINITY, TEX.—It is reported that the Trinity Electric Company is planning to install an electric light plant in this town. A. R. McDonald is interested in the enterprise.

TULIA, TEX.—The Tulia Light & Ice Company, recently incorporated, is planning to erect a power house. It is stated that machinery for the plant has been purchased. The company is capitalized at $10,000. J. W. Schwartz is president.

UVALDE, TEX.—It is reported that the property and holdings of the Uvalde Street Railway Company have been taken over by Charles Peterson, A. M. Avart and M. M. McFarland. It is said that the railway will be eventually extended to Batesville, a distance of about 20 miles.

VELASCO, TEX.—Thomas M. Morrison, of Robinson, Ill., is reported to be interested in a project to establish an electric light plant in Velasco.

PORTSMOUTH, VA.—The Portsmouth & Norfolk Corporation, which recently secured a franchise from the city of Portsmouth to erect transmission lines in this city, has been given permission by the Board of Supervisors of Norfolk County to install and operate an electric system on the streets of the county.

RICHMOND, VA.—The Common Council has sustained the action of Mayor Richardson in vetoing the award of the contract to the General Electric Company for equipment for the municipal electric light plant. It will now be necessary to call for new bids for the entire equipment of the proposed plant.

RICHMOND, VA.—The purchasers of the properties of the Virginia Passenger & Power Company have made arrangements, subject to the court's order, to take over the properties June 30. The new company will be known as the Virginia Railway & Power Company, of which Frank J. Gould is head. The company's plans, while not announced definitely, are said to include large expenditures for increased facilities and improvement of the service.

WINCHESTER, VA.—The Virginia Woolen Company has commenced work on the construction of the addition to its building, in which additional machinery will be installed at a cost of $8,000. The mill will be equipped for electric motor drive.

NORTH YAKIMA, WASH.—It is reported that the Northwest Light & Power Company, of which Robert E. Strahorn, of Spokane, Wash., is president, has offered to sell its plant to the town of North Yakima for $390,000. It is said that the town favors the purchase.

NORTH YAKIMA, WASH.—It is stated that the Hydro-Electric Power Company will soon apply to the City Council for a franchise to erect transmission lines on the streets of the city for the distribution of electricity. The company proposes to utilize the water power of the Yakima River north of the city and carry it in a flume into the Moxee Valley, where a plant will be erected.

PROSSER, WASH.—Plans are being prepared by the Prosser Power Company for the construction of a new power plant, which will utilize the wasted energy of the Prosser Falls and the rapids of the Yakima River to generate electricity, which will be transmitted to Prosser and surrounding section for lamps and motors, and also to operate pumps for irrigating the lands above Sunnyside. The initial equipment will include two units of 500 hp each.

GLENDALE, W. VA.—The Wheeling & Metal Manufacturing Company, it is said, will erect a new building at Glendale, and will be in the market for a gas engine and electric equipment for the same.

WHEELING, W. VA.—Plans are being made by the Sands Electrical Company to erect a 7-story building. A power plant will be installed in the building.

KENOSHA, WIS.—The Kenosha Gas & Electric Company is reported to have surrendered its franchise to the city and, in lieu of it, has taken an indeterminate permit under the public utility law of the State.

MILWAUKEE, WIS.—The Milwaukee Electric Railway & Light Company, it is reported, will build an addition to its power plant at West Allis.

MILWAUKEE, WIS.—The Nordberg Manufacturing Company is reported to have secured the contract for the engine for the new power plant of the Joseph Bach Estate, of Milwaukee; the Fort Wayne Electric Company for generator and the Ames Iron Works for boilers.

RICE LAKE, WIS.—The capital stock of the Rice Lake & Northwestern Telephone Company has been increased from $10,000 to $25,000.

WAUPUN, WIS.—Preparations are being made to rebuild the entire local telephone system this summer. A metallic system will be installed and 16,800 ft. of new cable will be erected.

WAUKESHA, WIS.—It is reported that the Waukesha Motor Company is asking for bids for part of its new plant, which is to be equipped to be operated by electricity. It is stated that the company has not yet decided whether to install its own generating plant.

CALGARY, ALTA., CAN.—The Calgary Power & Transmission Company is preparing plans for a power development this year at a cost of $700,000. Smith, Kerry & Chace, civil engineers, of Winnipeg, Man., and Toronto, Ont., are in charge of the work.

KELOWNA, B. C., CAN.—The municipal power plant which was recently destroyed by fire will soon be rebuilt.

VANCOUVER, B. C., CAN.—The Western Canada Power Company, recently incorporated with a capital of $5,000,000, has taken over all the holdings and franchise of the Stav Lake Power Company, which is building a plant 35 miles from this city. The company will increase the proposed development and promises to be ready to deliver 30,000 hp in Vancouver within 18 months.

VICTORIA, B. C., CAN.—The British Columbia Telephone Company has decided to place all its wires in Victoria under ground. In return for certain privileges the city will bear one-tenth of the cost of the work. The city also finances the scheme and the company pays interest and sinking-fund charges.

EMERSON, MAN., CAN.—It is reported that the Great Falls Power Company is contemplating the construction of a transmission line from Emerson to Grand Forks, N. D., for the purpose of supplying electricity in that city.

BROCKVILLE, ONT., CAN.—Mr. Conroy, of Aylmer, Que., has submitted a proposition to the Board of Light Commissioners to supply electricity in Brockville. Mr. Conroy represents a company which is prepared to utilize the water power of the Gatineau River and develop 50,000 hp, of which 20,000 hp would be delivered to Brockville at the rate of $20 per hp.

COBALT, ONT., CAN.—The contract for the construction of the proposed electric railway between Cobalt and Haileybury has been awarded to the Nova Scotia Construction Company, of Sydney, for $125,000. The railway will eventually be connected with North Bay.

HENSALL, ONT., CAN.—Tenders are now being received for the construction of a telephone system in Tuckersmith Township consisting of 100 miles of line and 230 telephones. For further information address A. G. Smilie, clerk.

NIAGARA FALLS, ONT., QUE.—The managers of the municipal electric light plant are making a test of a 25-cycle arc lamp and should it prove satisfactory it is said that the entire system will be changed, and that Superintendent G. E. Foster will be given authority to purchase transformers without the formality of applying to the Board of Aldermen, as heretofore.

OTTAWA, ONT., CAN.—It is reported that options are being taken on water powers about the City of Ottawa to be utilized to generate electricity for the proposed Morrisburg & Ottawa Railway. Under the present plans it is proposed to transmit electricity to Ottawa, where it will be used to operate the railway from Ottawa to Morrisburg; also for lamps and motors, to villages along the route.

TORONTO, ONT., CAN.—Bids will be received until July 6 by Adam Beck, chairman, Hydro-Electric Power Commission, Continental Life Building, Toronto, Ont., for the following work: 1, For construction of transformer station at Niagara Falls, Ont. 2, Transformer and interswitching station at Dundas, Ont. Plans and specifications may be obtained at the above office upon a deposit of $5 for each station, which will be returned upon receipt of bid or plans and specifications.

MONTREAL, QUE., CAN.—The Saraguay Electric & Water Company has submitted a proposition to the City Council offering to supply electricity in four city wards, and also agreeing to make a start on the municipal electric light plant at advantageous terms. The company is willing to furnish electricity for lighting the whole city if sufficient time is given them to make preparations. The company offers to furnish the city with electrical service until the city is ready to install a municipal electric plant without further cost other than the annual cost of the lamps, the city to purchase the lamps then installed in the streets at their actual value, and also offers the use of its poles in case it decides to take over the street lighting system, the price for same to be fixed by the Public Utility Commission. The company will be prepared to furnish electricity in Duvernay, St. Jean Baptiste, St. Louis and Lafontaine wards within three or four months.

HANLEY, SASK., CAN.—The Hanley Rural Telephone Company, recently organized, has decided to build 40 miles of telephone line this year. D. M. Dilley has been appointed organizer and manager of the company.

HANLEY, SASK., CAN.—The Council is negotiating with the Saskatchewan Government for a local telephone system to be built this year either by the province or by the town with provincial assistance. For further information address G. F. Daintree.

MELVILLE, SASK., CAN.—The Council has appointed a deputation of ratepayers to wait on the Provincial department of telephones for the purpose of securing a local telephone system and long-distance connection. For further information address Leon Benoilt, of Melville, Sask.

REGINA, SASK., CAN.—The ratepayers have voted in favor of the proposition to issue $78,000 in bonds, the proceeds to be used for the construction of a municipal electric light plant.

CHIHUAHUA, MEX.—It is reported that the Mexican Northern Electric Power Company will commence work within 60 days on the construction of a large dam on the Conchos River, about 17 miles above Sta. Rosalia, Chihuahua, to utilize the water power for a hydro-electric plant and for irrigation purposes. It is estimated that 40,000 hp can be developed, which will be transmitted to the mining districts of Parral, Almoloya and Sta. Eulalia and to Chihuahua and other towns. C. F. Greenwood, of Montreal, Que., Can., is president of the company.

New Industrial Companies.

THE ALTON LIGHT MANUFACTURING COMPANY has filed articles of incorporation with the Secretary of State at Wilmington, Del., with a capital stock of $300,000. The incorporators are E. J. Forhan, H. M. Browne and J. J. Harper, of New York, N. Y.

THE DOTHAN PLUMBING & ELECTRIC COMPANY, of Dothan, Ala., has been chartered with a capital stock of $20,000 by J. E. Wise, W. C. Fenn and F. A. Koepetke.

THE ELECTRIC CONSTRUCTION COMPANY, of Atlanta, Ga., has been incorporated with a capital stock of $12,000 by Charles M. Coyne, William M. Gregory, J. Prince Coyne and others. The company proposes to do general electrical construction work.

THE ELECTRICAL ENGINEERING & SUPPLY COMPANY, of Richmond, Va., has filed articles of incorporation with a capital stock of $10,000 for the purpose of dealing in electrical supplies. F. J. Whybrew is president; E. M. Thomas, vice-president and J. A. Hoofnagle, secretary and treasurer.

THE ELMWOOD CONSTRUCTION COMPANY has filed articles of incorporation with the Secretary of State at Wilmington, Del., with a capital stock of $100,000. The incorporators are M. McNulty, T. P. Smart and G. H. B. Martin, of Philadelphia, Pa.

THE GULF MACHINE & ENGINEERING COMPANY, of Tampa, Fla., has been chartered with a capital stock of $10,000 for the purpose of doing a general engineering business. The officers are: C. J. Belgau, president; H. C. Gordon, vice-president and G. P. Anderson, secretary and treasurer

THE INTERNATIONAL ELECTRIC SUPPLY COMPANY, of El Paso, Tex., has been incorporated with a capital stock of $25,000 by J. D. Campbell, J. E. Townsend, M. Weber, A. L. Sharpe and M. E. Goff.

THE K. E. AUTO ELECTRIC MANUFACTURING COMPANY, of Gadsden, Ala., has been incorporated with a capital stock of $10,000 to manufacture automobiles. The officers are: Kyle Elliott, president; T. G. Erwin, vice-president and L. C. Kyle, general manager and secretary.

ARTHUR D LITTLE, of Boston, Mass., has filed articles of incorporation, with a capital stock of $175,000, for the purpose of doing a general electrical and mechanical engineering business. A. D. Little is president and H. S. Mork, treasurer.

THE MARINE POWER SYNDICATE, of New York, N. Y., has been incorporated, with a capital stock of $500,000, by H. S. Graves, R. M. Miles, Jr., and C. S. Towger, all of New York, N. Y. The company proposes to manufacture power machinery.

THE NORTHWESTERN CONSTRUCTION COMPANY, of Milwaukee, Wis., has been incorporated by C. B. Holder, A. E. Reichert and E. M. Daniell.

THE PHILADELPHIA LAMP MANUFACTURING COMPANY, of Wilmington, Del., has been incorporated with a capital stock of $100,000 by R. N. Kerr, of Philadelphia, Pa.; M. E. Smith and T. J. Smith, both of Wilmington, Del.

THE RICE GAS ENGINE COMPANY, of Jersey City, N. J., has been chartered, with a capital stock of $1,000,000, by Arthur J. Denshan, Robert D. Harma and J. D. Baker. The company proposes to manufacture engines, tools, machinery, etc.

THE W. B. SMITH COMPANY, of Montpelier, Ind., has been incorporated to manufacture and deal in electrical supplies. The incorporators are: W. B. Smith, T. J. Driscoll and F. C. Neal.

THE SONORA CONSTRUCTION COMPANY, of Kerhonkson, N. Y., has filed articles of incorporation with a capital stock of $100,000 for the purpose of doing a general contracting, engineering and construction business. The incorporators are: C. H. Marshall, F. M. Van Wagoner and K. A. Fox, of New York, N. Y.

THE TEMPLE ELECTRIC-LIGHT GARAGE COMPANY, of Temple, Okla., has been incorporated with a capital stock of $5,000 by W. S. Brown, W. F. Evans, D. S. Tandy and J. C. Tandy.

THE YOUNG & TALBOT COMPANY, of Boston, Mass., has been chartered with a capital stock of $50,000 for the purpose of manufacturing and dealing in machinery. E. A. Young, of Boston, Mass., is president, and J. N. Talbot, of Dorchester, Mass., treasurer.

New Incorporations.

MOLINA, COL.—The Plateau Valley Telephone Company has been incorporated with a capital stock of $50,000 by K. C. Hill, John G. Hill, John H. Jenson, John S. Peugh and Claude W. Moore.

WILMINGTON, DEL.—The Merchants' Electric Company has filed articles of incorporation with a capital stock of $150,000. The incorporators are: H. H. Ward, G. G. Steigler and A. C. Gray, all of Wilmington, Del.

ALDRIDGE, ILL.—The Preston Union Telephone Company has been incorporated with a capital stock of $2,500 by Dr. C. D. Gardiner, of Grand Tower, Ill.

EUREKA, ILL.—The Eureka Telephone Company has been incorporated with a capital stock of $5,000 by C. J. Gibson, D. H. Schertz and A. L. Wood.

HARRISBURG, ILL.—The Saline County Light & Water Company has filed articles of incorporation with a capital stock of $5,000. The incorporators are: A. C. Murray, Walter L. Murphy and W. M. Timmons.

ANDERSON, IND.—The Batesville Gas & Light Company has incorporated with a capital stock of $50,000. C. M. Hoover, J. C. Vance and B. D. Emanuel are directors.

WASHINGTON, IND.—Articles of incorporation have been filed for the Farmers' Washingtown Township Home Telephone Company by John Kariger, John Oswald, William E. Miner, Leonard Stolte, William Kammier and others. The company is capitalized at $1,000.

BRIDGEWATER, MAINE.—Articles of incorporation have been filed for the Bridgewater Electric Company. The company is capitalized at $10,000 and proposes to install an electric light plant in Bridgewater. J. H. Farley is president; K. J. C. Burt, treasurer, and E. B. Morton, clerk, all of Bridgewater.

MILO, MAINE.—The Milo Telephone Company has been chartered with a capital stock of $5,000 and the following named officers: F. W. Hamlin, president; H. W. Hamlin, treasurer, both of Milo, and W. H. Monroe, of Brownville, Maine, clerk.

CAMDEN, N. J.—The Eastern Light & Fuel Company has been incorporated with a capital stock of $200,000 by William B. McDonald, of Camden, N. J.; William E. Stokes and Benjamin L. Van Schalck, of Philadelphia, Pa. The company proposes to generate electricity for light, heat and power.

NELSONVILLE, OHIO.—Articles of incorporation have been filed for the Hocking-Sunday Creek Traction Company by E. B. Young, J. Gaston Coe, M. A. King, Charles A. Vorhes, Warren N. Badger, H. H. Isler and Charles E. Poston. The company is capitalized at $300,000 and proposes to construct an electric railway from Nelsonville to Athens with branches to Chauncey and from Sugar Creek to the Sugar Creek coal mines.

BARTLESVILLE, OKLA.—The Bartlesville Light & Power Company has been incorporated with a capital stock of $200,000 by L. A. Rowland, S. J. Smallwood and R. L. Beattie.

HACKBERRY, OKLA.—The South Persimmon Telephone Company has been chartered with a capital stock of $2,450 and the following named directors: Samuel Halley, Silas Phillips, E. J. Healey, G. L. Jones, E. P. Burdick, D. H. Keller, James Stewart and Sherman Johnson, all of Hackberry.

PHILADELPHIA, PA.—A charter has been granted to the Philadelphia Suburban Traction Company to construct an electric railway from Southampton through Davisville and Johnsville to Hatboro, 3½ miles in length. The company is capitalized at $25,000 and the incorporators are: W. E. Watts, of Dubois, Pa., president; John L. Grogan, H. C. Case, and J. A. Bonnell, of Philadelphia, Pa.; and W. A. Merrick, of Newton, Pa.

SALTSBURG, PA.—The Eldersridge & West Lebanon Telephone Company has been formed to erect a telephone line between Saltsburg and Nowrytown. The incorporators are: J. F. Hood, C. Hood, Dr. J. T. Cass, J. T. McLaughlin, J. H. Henderson, of Saltsburg, and others.

ALTAMONT, TENN.—Articles of incorporation have been filed for the Citizens' Telephone Company by J. P. D. Hobbs, W. S. Cain, W. A. Hobbs and others. The company is capitalized at $4,000.

BUTLER'S LANDING, TENN.—Articles of incorporation have been filed for the Butlers' Landing Home Telephone Company, with a capital stock of $6,000, by T. W. Roberts, V. B. Mayfield, J. A. Roberts, J. M. Lynch and W. B. Clark.

WESTMORELAND, TENN.—The Westmoreland & Red Boiling Springs Railroad Company has applied for a charter to construct an electric railway from Westmoreland to Red Boiling Springs. The company will be capitalized at $5,000, and the incorporators are A. R. Dean, H. C. Smith, E. K. Laneb, W. A. Smith and J. B. Kemp.

WOODBURY, TENN.—Articles of incorporation have been filed for the Home Telephone Company, of Woodbury. The capital stock is placed at $5,000 and the incorporators are: Jesse Davenport, L. H. McCrary, J. P. Wood, Walter Hancock and others.

CRYSTAL CITY, TEX.—The Crystal City Telephone Company has been incorporated with a capital stock of $10,000 by William Cook, B. F. Cook and J. B. Dennis.

Personal.

MR. T. D. COGGSWELL, formerly of the commercial department of the Denver Gas & Electric Company, has been appointed commercial manager of the Electric Bond & Share Company.

MR. HARMAN S. SALT, 114 Liberty Street, New York, N. Y., has been appointed New York representative of Mathias Klein & Sons, Chicago, manufacturers of linemen's and construction tools.

MR. H. M. HIRSCHBERG, president of the Excello Arc Lamp Company, has returned from Europe, where he found a general satisfactory condition in the flaming-arc-lamp field and many developments of great interest.

MR. FRANK D. MURPHY has been appointed manager of the commercial department of the Elmira Water, Light & Railway Company, of Elmira, N. Y. Mr. D. F. Harrington has been made assistant superintendent of the distribution system.

MR. FRED J. POSTEL and MR. HOMER R. LINN, constituting the engineering firm of Postel & Linn at 279 Dearborn Street, Chicago, have dissolved partnership by mutual consent. A new firm known as F. J. Postel & Company will practice engineering at the old office.

MR. JOHN E. ERICSON, city engineer of Chicago, has been decorated with the Order of Vasa by the King of Sweden in recognition of his professional work. Mr. Ericson is a native of Sweden and has several times refused flattering offers to return to his native country.

MR. HENRY FLOY, consulting engineer, has been retained by Mr. B. J. Arnold in direct charge of the appraisal of the street railways in Greater New York and the elevated railways in Brooklyn, which Mr. Arnold is making for the Public Service Commission of the First District.

MR. H. H. SINCLAIR, vice-president of the Edison Electric Company, of Los Angeles, has been appointed vice-president and general manager of the Great Western Power Company, with offices in the Crocker Building, San Francisco. Mr. Sinclair will continue as vice-president of the Los Angeles company.

MR. ALTON S. MILLER, general manager of the Consolidated Gas, Electric Light & Power Company, of Baltimore, Md., has resigned and has accepted the position of general manager and vice-president of the Union Electric Light & Power Company, of St. Louis. Mr. Miller has held his Baltimore position since 1902.

MR. W. J. HAMMER represented the American Institute of Electrical Engineers on the occasion of the presentation of the gold medals of the Aero Club of America to Messrs. Wilbur and Orville Wright by President Taft in the East Room of the White House on June 10, 1909. Mr. Hammer also represented the Aeronautic Society of New York. The Franklin Institute was officially represented on this occasion by Messrs. Emile Berliner, of Washington, D. C., and Mr. Charles Day, of Philadelphia. All three of the delegates are members of the Aero Club of America.

MESSRS. R. PFEIL, A. HETTLER and H. MEYER, of the Siemens & Halske Company, of Berlin, sailed for home on June 19 by the *Amerika* after a very brisk and crowded trip of three weeks around the country. They visited a number of plants, factories and installations, and were greatly pleased with all the interesting things they saw, though by no means dissatisfied with the results of the comparisons natural to occur between their own country and this. There are always pleasure and profit in the visit of such trained observers. On the Friday evening before their departure a dinner party was given in the pergola of the Hotel Astor which lasted pretty well until the hour for going aboard. Director Pfeil had not been here for several years, but hopes soon to make another visit.

DR. HAROLD PENDER has been appointed to the chair of theoretical and applied electricity in the department of electrical engineering of the Massachusetts Institute of Technology. Dr. Pender was graduated from the Johns Hopkins University in 1901 with the degree of Ph. D., and thereafter taught for a year and a half, during which period he repeated the classical experiment of Prof. Rowland which demonstrated the magnetic effect of a moving charge of electricity. M. Cremieux, of Paris, having challenged the accuracy of the Rowland method, and devised an experiment which appeared to substantiate his criticism, Poincare, the eminent French mathematical physicist (recently elected a member of the French Academy), suggested the desirability of demonstrating the two experiment which appeared to substantiate his criticism, Poincaré, the Cremieux. An arrangement was then made whereby the expense entailed would be divided between the French Academy of Sciences and the Carnegie Institution, and Dr. Pender was sent to Paris on the part of the Carnegie Institution, where he established the inaccuracy in the Cremieux experiment, which the author acknowledged, and also established to the satisfaction of the latter the accuracy of the Rowland experiment. Upon returning from France Dr. Pender entered the employ of the Westinghouse Electric & Manufacturing Company. He has since been engaged in regular engineering work, having recently been associated with Dr. Cary T. Hutchinson.

Trade Publications.

MOTORS FOR SHOP AND OFFICE USE.—The Westinghouse Electric & Manufacturing Company has issued Folder No. 4132, showing the application of standard small motors rated at 1/20, 1/12, 1/8, 1/6 and 1/4 hp for domestic and commercial purposes.

ELECTRIC SPECIALTIES.—Catalog No. 10 of the Crescent Company, of Valparaiso, Ind., contains descriptions and illustrations of the specialties made by the company. These include incandescent lamp guards, cord adjusters, lamp cleaners and lamp removers, coloring fluids, torches, soldering salts and paste, time switches, clusters, etc.

EXCELLO DUPLEX ARC LAMP.—The Excello Arc Lamp Company has a bulletin (No. 102) devoted to its new Duplex arc lamp. This is a double-trim lamp burning 30 hours per trim and has been favorably received in England and Germany, and has already attracted a great deal of attention among the American engineers.

ELMER P. MORRIS CO., 90 West Street, New York City, has just published a handsome broadsheet in colors, brass bound, of the Panama Canal, and of the Western Hemisphere in its relation thereto. A profile of the canal is also given, and a cross section of the Culebra Cut. Mr. Morris will be glad to furnish this on application.

RESISTANCE UNITS.—The Di-el-ite Manufacturing Company, of Philadelphia, Pa., has issued a small leaflet in which are listed the various resistance units made by the company. The insulation used in these units is an artificial stone peculiarly adapted for electrical work. High-grade resistance wire or strip is employed, which is embedded in the di-el-ite, forming a solid unit.

PASTE LUBRICANT.—Oildag is a mixture of deflocculated, unctuous graphite and oil which possesses excellent lubricating properties. The properties of this paste are set forth in a folder issued by the Acheson Oildag Company, of Niagara Falls, N. Y. The company has also issued in pamphlet forms the reports of Prof. C. F. Mabery and committees of the Automobile Company of America on the lubricant.

LIGHTNING ARRESTERS.—The General Electric Company has issued Bulletin No. 4663 covering lightning arresters for both alternating and direct-current circuits. The arresters consists of a series of spark gaps shunted by graded resistances but without series resistance. The bulletin gives detailed information with regard to the various types of multi-gap arresters together with curves, illustrations, dimensions and connections, covering not only the arresters, but the auxiliary apparatus as well.

ELECTRIC VENTILATING SETS.—The B. F. Sturtevant Company, of Hyde Park, Mass., has issued Bulletin No. 106 describing its ready-to-run fans for household and other uses. The fans are of the multivane type, each fan wheel being made up of 60 spooned blades and attached to the shaft of a direct-current or alternating-current motor. The three sizes exhaust 150, 300 and 450 cu. ft. of air per minute and weigh 25, 35 and 50 lb., respectively. The outfits are applicable for ventilating rooms and offices and may also be used for blowing furnaces during the winter months.

ALUMINUM LIGHTNING ARRESTERS.—The General Electric Company's Bulletin No. 4661 is devoted to aluminum lightning arresters for alternating-current circuits of from 4600 to 110,000 volts. The arresters are built up of a number of aluminum plates immersed in an electrolyte. An hydroxide film on the surface of the plate allows a low current flow up to a certain voltage, and at a higher voltage the flow is limited only by the internal resistance of the cell which is stated to be very low. The arresters have large discharge capacity and take care of continuous and recurrent discharges.

Business Notes.

THE KUHLMAN ELECTRIC COMPANY, of Elkhart, Ind., has opened a New York office at 30 Greenwich Avenue, New York City, where all information in regard to its transformers will be supplied.

THE WATSON MACHINE COMPANY, Paterson, N. J., announces that, in addition to the cordage machinery which it has manufactured for the past 20 years, it has now added a complete line of wire-stranding, cabling, armoring, insulating and wire-rope making machines, having effected a combination with Mr. Thomas A. Aiton, who has made a specialty of this class of machinery for the past 12 years, both in this country and Europe. Mr. Aiton has entered the firm as general manager and is giving his special attention to this business.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 15, 1909.

[Conducted by Wm. F. Bissing, Pat. Law, 2 Rector St., N. Y. City.]

924,628. SYSTEM OF ELECTRICAL DISTRIBUTION; R. Braun, Manchester, Eng. App. filed Oct. 3, 1906. A load equalizer for alternating current, including a rotary converter, a direct-current dynamo electrically coupled thereto and having a flywheel, with means for varying the field strength of the dynamo as the load varies.

924,666. SYSTEM OF CONTROL; H. D. James, Pittsburgh, Pa. App. filed Oct. 3, 1906. A plurality of separately actuated main switches and automatically operated relay and interlocking switches which cause the main switches to operate in either forward or reverse order.

924,667. CONTROL SYSTEM FOR ELECTRIC MOTORS; H. D. James, Pittsburgh, Pa. App. filed Oct. 3, 1906. A generator and motor with their armatures electrically connected and resistances in the circuits of the respective fields which are operated to prevent too rapid acceleration in the speed of the motor.

924,670. SIGNAL SYSTEM; W. H. Kirnan, Bayonne, N. J. App. filed Feb. 10, 1909. A plurality of street circuit relays actuating circuit controllers which disconnect the contacts of other street circuit relays from the circuit.

924,680. AUTOMATIC VALVE CONTROLLER; N. C. Locke, Salem, Mass. App. filed Oct. 15, 1907. For an automatic engine stop in which the valve is electrically controlled.

924,712. POLE CHANGER; N. L. Wine, Polo, Ill. App. filed July 10, 1907. For producing pulsating direct currents of positive and negative polarity from the same source, and also alternating currents, by means of a rotary pole changer.

924,714. TELEPHONE SYSTEM; E. E. Yaxley, Chicago, Ill. App. filed Jan. 18, 1909. The common source of direct current supplies magnetism to the telephone receivers instead of using permanent magnets therefor.

924,716. BRUSH HOLDER FOR DYNAMO ELECTRIC MACHINES OR MOTORS; C. E. K. Zachau, Muskegon, Mich. App. filed Jan. 10, 1907. A bracket having a cam surface, a brush-holding frame and a link pivotally connecting bracket and frame with a spring to hold the frame against the cam.

924,725. SINGLE-PHASE MOTOR; S. R. Bergman, Lynn, Mass. App. filed June 5, 1908. Self-starting motor having an open-slotted stator with the main winding in some of the slots and the starting winding in the remaining slots, magnetic wedges to close the main slots and non-magnetic wedges to close the starting slots.

924,727. TARGET SIGNAL; E. F. Bliss, Schenectady, N. Y. App. filed July 15, 1908. A three-position target signal consisting of two targets pivotally mounted on a common axis, means for actuating each target independentiy of the other.

924,735. AUTOMATIC ELECTRIC INTERLOCK SYSTEM; J. F. Clark, Christopher, Ill. App. filed July 27, 1907. Intersecting railway tracks are provided with side tracks, switches and signals, the switches having circuits closed by an approaching train so as to side track the train and then return the switches.

924,782. FLEXIBLE CONDUIT; O. Hoppe, Brookline, Mass. App. filed June 15, 1908. For electrical conductors in which the tube is formed of a strip of spirally wound resilient material.

924,784. TROLLEY-POLE GUIDING AND FINDING DEVICE; J. J. Jagolin, Paterson, N. J. App. filed March 7, 1908. A finder is provided with a casing having converging cam slots that control forwardly and backwardly yielding fingers normally pressed out by springs.

924,785. SYSTEM OF ELECTRIC MOTOR CONTROL; H. D. James and W. A. Dick, Pittsburgh, Pa. App. filed Oct. 18, 1907. Means for governing the field resistance of a generator driven by an induction motor, the action of the field governor being delayed.

924,786. SYSTEM OF ELECTRIC MOTOR CONTROL; H. D. James, Pittsburgh, Pa. App. filed Nov. 8, 1907. For electric motors operating large variable loads which are provided with a limit switch for bringing the motor to rest and means for slowing down the motor by weakening the field of the generator.

924,799. ELECTRICAL EQUALIZING SYSTEM; B. G. Lamme, Pittsburgh, Pa. App. filed Sept. 3, 1907. The dynamo has a mechanically coupled flywheel and is connected with the distributing circuit without the intervention of a rotary converter.

924,800. ELECTRIC SIGNAL MECHANISM FOR OVERHEAD TROLLEY SYSTEMS; H. A. Lines, West Haven, Conn. App. filed Dec. 23, 1908. Throws the lights on or off at the end of the block when the trolley car passes by means of an arm in the path of the trolley pole which controls a circuit.

924,804. ELECTRIC SLIDING OR OTHER CONTACT; V. Lowendahl, Stockholm, Sweden. App. filed March 16, 1908. For brush holders in which the metallic part is formed of metal and the second part of carbon and metal, the latter being inserted in a groove in the former.

924,826. BATTERY CONNECTION; O. E. Pettee, Rockland, Me. App. filed Oct. 14, 1908. Consists of a pin, a pocket and a pair of clamping jaws located between the pin and the pocket.

924,827. OSCILLATION RECEIVER; G. W. Pickard, Amesbury, Mass. App. filed Sept. 16, 1907. A pair of electrical conductors, brass and oxide of zinc possessing rectifying properties are placed in contact with a small thread contact between them.

924,844. FUSE BOX; H. W. Sheehy, Akron, Ohio. App. filed May 5, 1908. Consists of a casing with a reversible cutter and a fuse wire on each side of the cutter.

924,857. CONSTANT-CURRENT REGULATOR; A. A. Tirrill, Schenectady, N. Y. App. filed Nov. 4, 1907. Boosters in series with a storage battery are controlled so that the battery takes its share of the load, the booster being provided with differential field coils, one of which is varied so that the resultant of the two gives the proper magnetic flux.

924,860. RENEWABLE FUSE FOR ELECTRIC CIRCUITS; J. A. Volk, Jr., South Norwalk, Conn. App. filed March 25, 1908. Has an insulating tube with plugs having peripheral channels and a low melting fuse passing diagonally through the tubes and through the channels.

924,868. ELECTRIC WELDING MACHINE; W. C. Winfield and A. C. Taylor, Warren, Ohio. App. filed Feb. 17, 1908. For welding the seams of pipes and wheel rims. The machine has two lower work clamping and conducting jaws and two upper jaws, between which the pipe is placed.

924,910. SAFETY DEVICE FOR RAILROADS; J. W. Ledwon, South River, N. J. App. filed Oct. 27, 1908. For preventing collisions between two trains. Levers rocked by wheels of the locomotive and located along the track control electric circuits so as to give a signal in the cab of the other locomotive.

924,916. ARC LAMP; B. Monasch, Berlin, Germany. App. filed July 9, 1908. Arc lamps with converging electrodes; prevent creeping up of the arc by providing a magnet traveling downward with the electrode, which when it approaches the arc blows it out.

924,927. ELECTRICAL EQUALIZING SYSTEM; J. S. Peck, Manchester, Eng. App. filed Nov. 8, 1907. A dynamo has a flywheel mechanically coupled thereto and is connected with the distributing circuit without the intervention of a rotary converter.

924,952. SNAP SWITCH; J. H. Wyatt, Philadelphia, Pa. App. filed April 28, 1908. The contact carrying member is restrained in both positions by a detent actuated by a spring.

924,968. ELECTRICAL SIGNALING SYSTEM FOR RAILWAYS; C. Crandall, Newport, R. I. App. filed July 2, 1908. For signaling engineers of locomotives by means of semaphores, and wireless transmission from the line to an aerial on the locomotive.

924,975. VAPOR ELECTRIC LAMP; S. Ferguson, Schenectady, N. Y. App. filed June 29, 1904. A solenoid with a vapor electric device having a contact making cap and a spring contact in the interior of the solenoid for engaging with the cap.

924,977. ELECTRICAL APPARATUS; W. J. Foster, Schenectady, N. Y. App. filed Feb. 1, 1906. Short-circuiting collars for the pole pieces of dynamos having ribs to diminish the transfer of heat from the conductor to the collar.

924,989. MERCURY METER; F. Holden, London, Eng. App. filed March 19, 1907. Improved construction of paddle wheel for a mercury meter containing a mercury chamber in which the wheel is located.

924,991. ALTERNATING-CURRENT, DYNAMO-ELECTRIC MACHINE; D. C. Jackson, Madison, Wis. App. filed Feb. 23, 1904. For controlling the speed and torque of an alternating-current motor by having a field magnet supplied with alternating-current, a commutated winding and a second set of brushes which reduces the sparking and provides a more accurate speed regulation.

924,992. DYNAMO-ELECTRIC MACHINE; D. C. Jackson, Madison, Wis. App. filed Oct. 23, 1905. An armature with a commutated winding, a resistance in the conductor connecting the winding with the commutator, and induction coils bridged between adjacent conductors at a point between the resistances and the armature winding.

925,026. BLOCK-SIGNAL SYSTEM; F. Rhea, Schenectady, N. Y. App. filed April 6, 1909. Inserts a reactive winding in the track circuit and employs the voltage drop produced thereby for actuating the track relay to initiate an additional signal movement.

925,050. ELECTRIC HEATING DEVICE; W. Sprenger, Lynn, Mass. App. filed March 30, 1908. An electrically heated tool, a supporting stand, and connections whereby the heating current is cut off the tool and applied to the stand when the tool is placed on the stand.

925,054. PROTECTIVE DEVICE FOR ELECTRIC CIRCUITS; J. B. Taylor and D. S. Carpenter, Schenectady, N. Y. App. filed March 15, 1907. The switch has a movable blade for each side of the circuit; a line discharge terminal is mounted on each blade and a grounded discharge terminal co-operates with both line terminals when the switch is closed.

925,055. MEASURING INSTRUMENT; E. Thomson, Swampscott, Mass. App. filed May 11, 1908. Hot-wire instrument for measuring alternating current by means of the tone produced by the currents passing through the wire.

925,056. ELECTRIC SOLDERING IRON; T. Van Aller, Schenectady, N. Y. App. filed March 25, 1908. A soldering iron having an electric heating unit and a separable tip in heat-conductive relation to the unit.

925,060. VAPOR-ELECTRIC APPARATUS; E. Weintraub, Schenectady, N. Y. App. filed Dec. 21, 1903. A vaporizable cathode, a receiver for wireless waves and means controlled by the waves for starting the lamp or cathode to act as a receiver.

925,064. ELECTRIC METER; W. R. Whitney, Schenectady, N. Y. App. filed March 16, 1907. An electric meter whose electrolyte is permanently changed in color by reaction with ions and a source of electromotive force to cause the ions to migrate through the electrolyte.

925,069. RHEOSTAT; P. H. Zimmer, Schenectady, N. Y. App. filed April 6, 1908. A rheostat having a series of contacts with a controlling arm biased to initial position, a member frictionally engaged with the arm and a no-voltage magnet for holding the member.

925,093. SUPPLY SYSTEM FOR TELEPHONE CIRCUITS; J. L. Hall, Schenectady, N. Y. App. filed June 8, 1906. Current supply systems for telephone circuits using a dynamo having a uniform homopolar field to avoid pulsations.

925,094. TROLLEY HARP AND WHEEL; F. E. Hancock, Sherman, Cal. App. filed April 20, 1908. The harp has side plates having slots in which the wheel arbor moves.

925,098. LOCK-OUT DEVICE FOR COMMON BATTERY TELEPHONES; R. D. Harris, J. E. Johnson and H. W. Soest, Fort Wayne, Ind. App. filed June 1, 1908. A number of telephones are operated from a common battery and the lock-out is arranged so, with the receiver in position, central by means of an alternating-current may ring the telephone bell, and permit the called subscriber to make the proper connections.

925,102. ELECTRICAL DISTRIBUTION SYSTEM; H. M. Hobart, London, Eng., and E. Coad, Bremen, Germany. App. filed Jan. 4, 1909. A transformer and auto-transformer are used in connection, a fraction of the transformer secondary being put in series with a fraction of the auto-transformer winding.

925,108. MOTOR-CONTROLLING DEVICE; R. M. Klein and D. R. Sperry, Madison, Wis. App. filed March 23, 1908. Motors are used in connection with automatic machines for varying their speed and have automatic starters, such as a rheostat with means for automatically varying the resistance of the rheostat to cause the motor to rotate at different speeds.

925,110. CAR-LIGHTING SYSTEM; S. Krohn, Charlottenburg, Germany. App. filed Feb. 28, 1907. A lighting system for electric cars

925,064.—Electric Meter.

having a plurality of sets of lamps, a source of current varying in potential and means for automatically changing the currents of the lamps from series to parallel as the potential supplied varies.

925,113. ELECTRICAL MEASURING INSTRUMENT; W. J. Lloyd, Rugby, Eng., and L. Wilson, Denver, Col. App. filed May 21, 1907. A measuring instrument having a high torque and uniform scale in which a current-carrying conductor moves in a magnetic field of varying strength and a magnetic control responsive to variations of strength in the field provides a counter torque to a spring acting on the conductor.

925,123. SIGNAL MECHANISM; W. V. Moak, Schenectady, N. Y. App. filed Nov. 18, 1908. A semaphore three-position signal worked from an electric motor. Details.

925,125. ELECTRIC METER; P. C. Morganthaler, Fort Wayne, Ind. App. filed Jan. 17, 1908. Improvements in shipping devices for meters to avoid breaking the jewel. The lower thrust-bearing is controlled by a lever, so that the shaft may be raised from the bearing.

925,132. DYNAMO-ELECTRIC MACHINE; H. G. Reist, Schenectady, N. Y. App. filed Feb. 29, 1908. For driving rolling mills in which a breakable spindle is placed between the dynamo-electric machine and the rolling mill.

925,137. AUTOMATIC BRAKE SYSTEM; W. U. G. Shaw and O. Johnson, Lafayette, Ind. App. filed Jan. 22, 1908. Electrically operated brake system for railways employing sectional ground conductors which close a circuit when two cars or engines are in the same bolck, shut off the power and apply the brakes.

925,155. ELECTRIC FLUID HEATER; C. C. Chesney, Pittsfield, Mass. and H. B. Wilson, Schenectady, N. Y. App. filed March 12, 1908. A continuous flow heater for heating water provided with a reservoir and pipe connections for maintaining a circulation between the reservoir and heater.

925,160. ELECTROMAGNETICALLY CONTROLLED SWITCH; A. S. Cubitt, Schenectady, N. Y. App. filed March 30, 1908. The operation of the switch is retarded for a time interval after the coil is energized. Details.

925,165. CONDENSER; A. R. Everest, Lynn, Mass. App. filed Aug. 7, 1905. A high-potential, large capacity condenser consisting of a box-like frame supporting pins of insulating material with plates of conducting material supported at their edges by the pins.

925,166. ARC LAMP; W. C. Fish and R. Fleming, Lynn, Mass. App. filed May 29, 1903. For flaming arcs in which the chimney can be readily removed for cleaning.

925,168. FASTENING FOR ELECTRICAL SIGN RECEPTACLES; E. H. Freeman, Trenton, N. J. App. filed Feb. 4, 1909. An electrical sign receptacle in which the supporting element has a plain round hole into which the receptacle can be inserted and is provided with keeper notches, a fastening device and binding screws.

925,171. CIGAR LIGHTER; A. C. Gruhlke, Waterloo, Ind. App. filed April 23, 1908. A torch cigar lighter which can be saturated with alcohol and ignited by an electrical spark.

925,179. TELPHER SYSTEM; B. W. Harris, Buffalo, N. Y. App. filed June 18, 1908. The cars are run by individual motors and travel on suitable tracks supplying current to the motor and supplied with current from a suitable generator.

925,185. ELECTRICITY METER; S. H. Holden, Birmingham, Eng. App. filed July 18, 1908. A continuous-current, watt-hour meter having an electromagnet, a mercury chamber and a disk armature in said chamber, a socket in the armature, a spindle in the socket and a removable brake disk on the spindle.

925,187. ELECTRICITY METER; G. Hookham, Birmingham, Eng. App. filed July 18, 1908. A motor mercury meter in which the armature revolves in a mercury bath and in which additional space for the mercury is provided and the mercury sealed up in transit to prevent loss by means of an auxiliary chamber.

925,225. SWITCH; L. Quattlebaum, Decatur, Miss. App. filed Oct. 29, 1908. A knifeblade switch in which the blade has a pivoted and sliding connection with a central terminal post so as to permit its engagement with either one or both of the end posts.

925,254. DYNAMO-ELECTRIC MACHINE; J. B. Wiard, Lynn, Mass. App. filed April 29, 1907. A dynamo having a distributed winding and a separate connection ring comprising an annular support and a plurality of independent conductors carried thereby for connecting between the coils.

925,270. ELECTRIC GEAR CHANGING MECHANISM FOR AUTOMOBILES; F. Beemer, Philadelphia, Pa. App. filed Aug. 5, 1907. A speed gear changed mechanism operated by solenoid magnets which throw the change gears in and out.

925,271. CORE SPACING MEMBER FOR DYNAMO-ELECTRIC MACHINES; B. A. Behrend, Norwood, Ohio. App. filed Aug. 31, 1906. For ventilating laminated cores by means of spacing members comprising toothed plates.

925,272. DYNAMO-ELECTRIC MACHINE; B. A. Behrend, Norwood, Ohio. App. filed May 27, 1907. A dynamo having a housing with hollow pedestals serving as conduits to admit air to the dynamo within the housing for cooling.

925,291. RECEIVER FOR WIRELESS SIGNALING; H. C. Cayley, Riverside, Cal. App. filed April 21, 1908. Makes use of an imperfect contact in which the pressure between the contacts is adjusted by means of an adjusting screw and a magnet.

925,293. CABLE CONDUCTOR; H. W. Cheney, Norwood, Ohio. App. filed Nov. 30, 1906. Two terminal members having interfitting parts held together by dowel pins and a split spring sleeve.

925,312. CENTRIPETAL ELECTRIC SWITCH; T. J. Downer, Colorado Springs, Col. App. filed April 13, 1908. The circuit is automatically broken by centrifugal force. Used on vehicles to sound a signal or to light a lamp.

925,321. PROCESS FOR FACING STEREOTYPE METAL; W. R. Fisher, San Francisco, Cal. App. filed Dec. 14, 1908. Facing stereotypes with copper by first washing and treating the plate and then electrodepositing the copper.

925,322. RAILWAY SIGNAL AND TRAIN CONTROLLING MECHANISM; E. E. Flora and R. J. Zorge, Chicago, Ill. App. filed May 13, 1908. For stopping a train if the alarm signal is not heeded by a combination of torpedo-placing mechanism with a train-controlling means located between the point to be protected and the torpedo placer and having a stop arm.

925,341. RHEOSTAT AND CONTROLLING DEVICE; H. D. James, Pittsburgh, Pa. App. filed March 31, 1909. A supply circuit, with two resistances in parallel thereto and a distributing circuit connected to the resistances and shunts for one-half of each of the resistances.

925,343. SWITCH FOR RAILWAYS; F. H. Kaiser, Buffalo, N. Y. App. filed Oct. 2, 1907. A switch for electric railways controlled by the current propelling the car, by means of a motor driving the switch point through a worm gear.

925,345. SWITCH AND DETECTOR BAR THROWING MECHANISM; C. R. Keeran, Bloomington, Ill. App. filed Feb. 19, 1908. For throwing switch points by electrical means, such as a motor, and for automatically locking the switch points during the initial part of the movement of the detector bar, the motor being connected to the switch by means of a clutch.

925,353. ELECTRIC SIGNALING SYSTEM FOR RAILWAYS; F. Lacroix, San Antonio, Tex. App. filed Jan. 24, 1907. A cab signal with means for sending signals from the cab, as well as receiving them.

925,355. METHOD OF AND MEANS FOR OPERATING DYNAMO-ELECTRIC MACHINES; B. G. Lamme, Pittsburgh, Pa. App. filed Aug. 2, 1906. For operating dynamos as generators or motors particularly. Alternating-current motors of the commutator type are employed to propel vehicles and to act as braking generators.

925,356. ELECTRICAL LOAD EQUALIZING SYSTEM; B. G. Lamme, Pittsburgh, Pa. App. filed Nov. 6, 1908. See 925,357. The field magnets are supplied with electromotive forces differing in phase from those of the circuit with which the armatures are associated, and the electromotive force of the armature circuits are associated in accordance with variations of amount of current required of the distributing circuit.

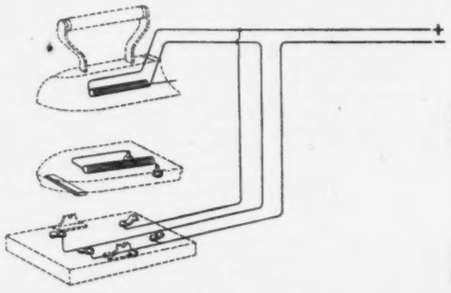
925,357. ELECTRICAL EQUALIZER SYSTEM; B. G. Lamme, Pittsburgh, Pa. App. filed Nov. 30, 1908. For polyphase system. Combines a two-phase distributing circuit with two mechanically coupled dynamos, each having its armature associated with one pair of conductors of the circuit and its field with the other pair.

925,365. METALLIZATION OF VITROUS CERAMIC SURFACES; Q. Marino, London, Eng. App. filed July 31, 1908. Deposits silver and a copper salt on earthenware.

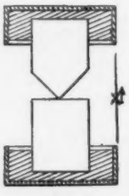
925,385. SYSTEM OF TRANSMISSION; E. Riecke, Berlin, Germany. App. filed March 20, 1908. For transmitting power to mills in which a flywheel motor generator is used, the flywheel acting on excessive loads. The voltage of the generator is decreased when the motor of the flywheel motor generator is overloaded.

925,392. DYNAMO-ELECTRIC MACHINE; G. B. Schley, Norwood, Ohio. App. filed Oct. 31, 1906. Particularly for three-wire systems in which a three-wire dynamo is provided with suitable field windings to prevent sparking at the brushes.

925,403. ELECTRICAL INDICATING INSTRUMENT; H. L. Van Valkenburg, Norwood, Ohio. App. filed Sept. 29, 1906. A movable



925,050.—Electric Heating Device.



924,827.—Oscillation Receiver.

scale and indicator, the scale remaining stationary until the indicator has moved a predetermined amount.

925,412. ELECTRIC INSTRUMENTS; H. G. Addie, Cresco, Ia. App. filed Feb. 5, 1908. For testing fuses to be carried in the pocket. A buzzer is located in the casing and also an electric lamp, the casing carrying contact members to complete the circuit.

925,420. MEANS FOR DISCONNECTING TELEPHONE LINES; M. Bowman, McHenry, Md. App. filed July 7, 1908. Makes and breaks the connection within the house by a controlling chain, on account of an approaching storm, etc.

925,439. GONG-STRIKING MECHANISM; H. E. Reeve, New York, N. Y. App. filed Jan. 22, 1909. An electromechanical bell driven by a spring train and checked by a stop having a rotatable hammer.

925,441. CIRCUIT BREAKER; H. W. Cheney, Norwood, Ohio. App. filed Sept. 25, 1905. For railways in which a pair of stationary contacts are bridged by a movable contact consisting of a bundle of laminæ, a holder having a pair of slotted ears, with a lever having projections engaging the slots and a spring between the lever and holder.

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"the defendant's [Sachs] safety-fuses are distinct combinations, both in respect to fuse protection and to exterior indication of the condition of the main fuse, and are not infringements."

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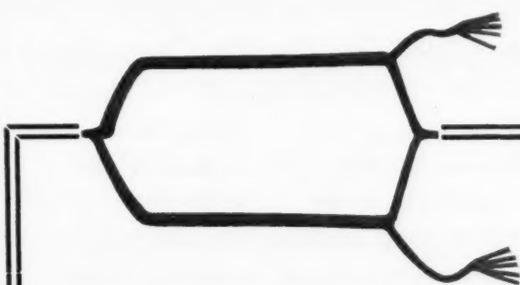

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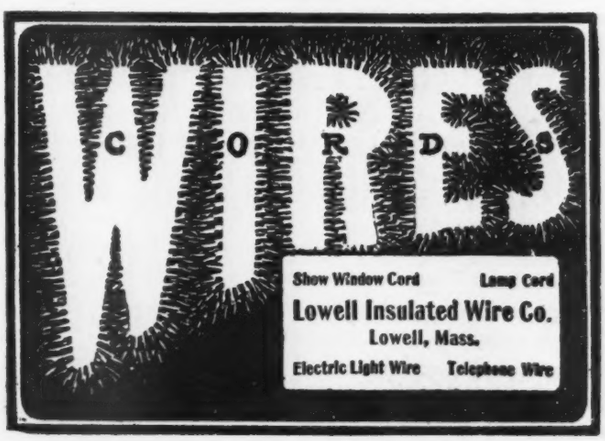

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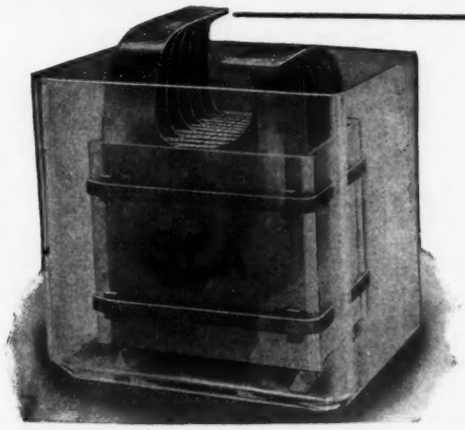

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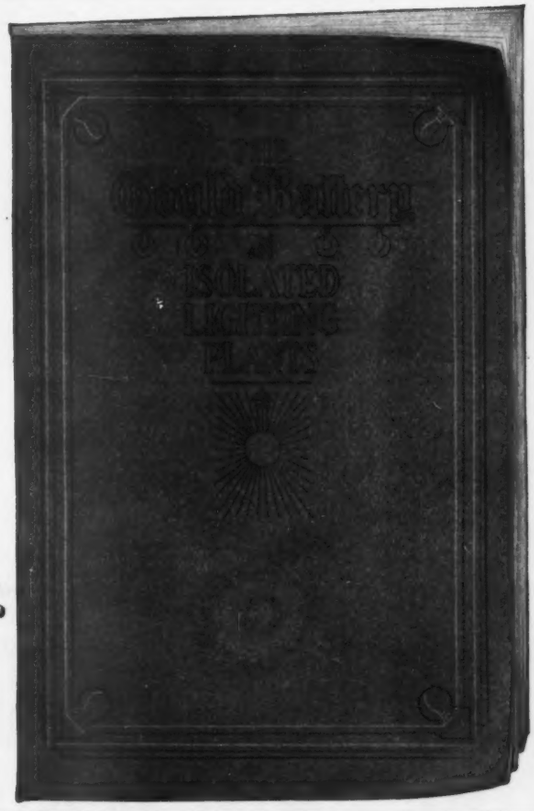

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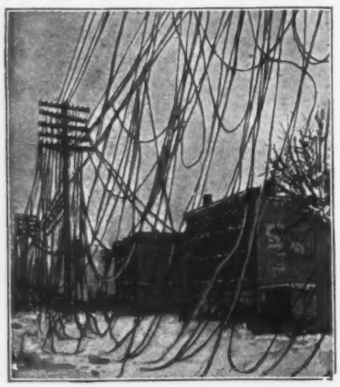

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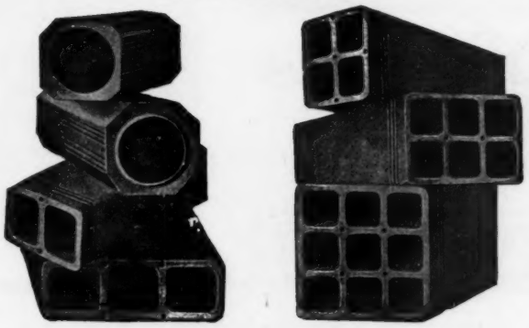

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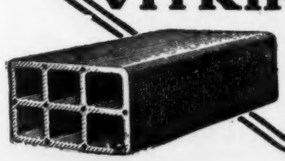

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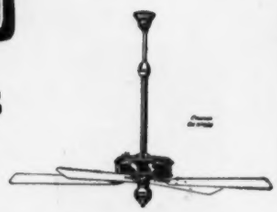

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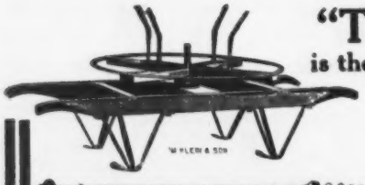

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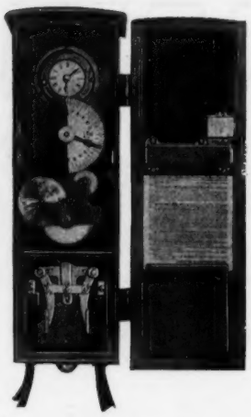

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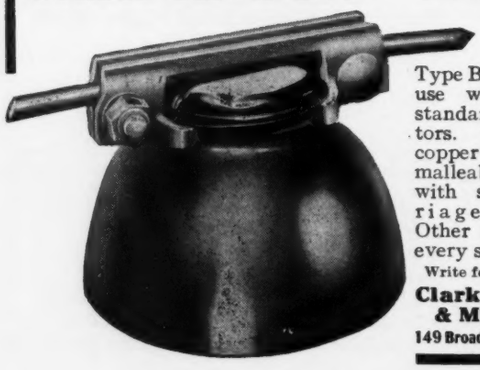

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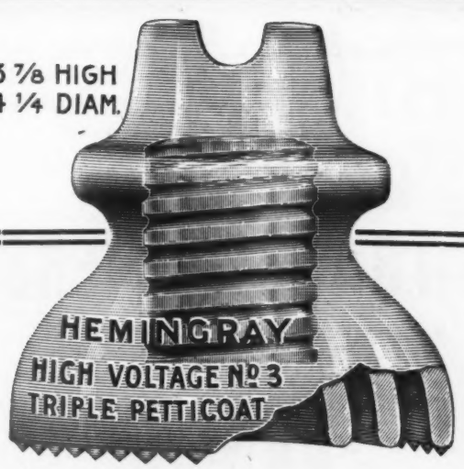

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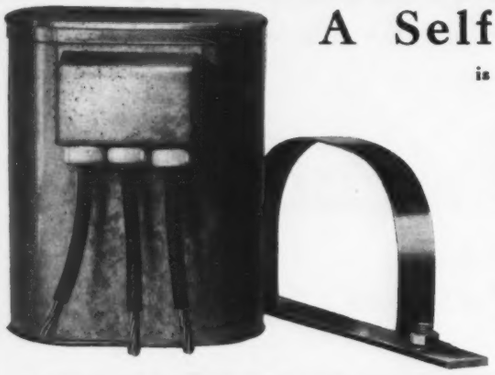

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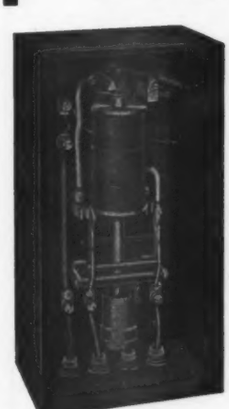

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that puts them in a class of their own. For instance: the P 25 Voltmeter, 2½-inch diameter, D'Arsonval type, in plush-lined, Morocco case, at $9.50, has no equal in the realm of instruments. Ask for Bulletin E. W.

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Siemens & Halske. A.G.

NEW YORK CITY
50 CHURCH STREET

Complete Meter Testing Outfit
for
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or
Direct Current

Portable Tachometers

Our No. 14 Hand Tachometer—for speeds from 30 to 4,000 revolutions per minute, is the only tachometer on the market fitted with *automatic range finding device*. If the speed to be tested is unknown the instrument automatically finds it. The speed ranges of the No. 14 are:

30-120
100-400
300-1200
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Other ranges to meet requirements.

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No. 4 Hand Tachometer

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90 West Street **New York**

Do You Want What's Coming to You?

Then serve your customers through the

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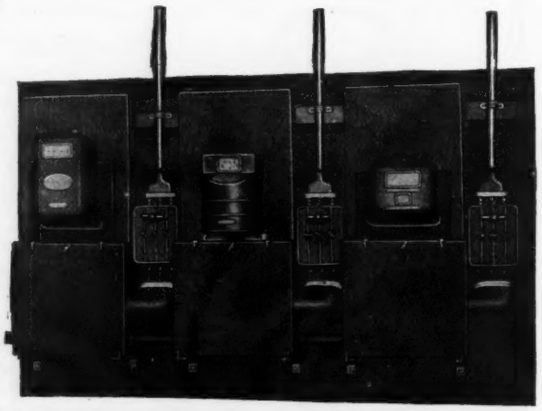
It is absolutely impossible to get at a wire on the service side of the meter without breaking the seal, and **theft** of current without immediate detection is impossible. We have printed a circular which gives all the details. Write for a copy.

The Ricker Mfg. Co. 300 North Water St. ROCHESTER, N. Y.



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Calibrated To An ACCURATE Standard
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Battery Ammeter
You'll save a lot of trouble by having one of these at hand. 0 to 30 amp. **$3.00**
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THE BEST THINGS OFTEN COME IN THE SMALLEST PACKAGES
PHANTOM LOADS
are made small and light for the convenience of meter inspectors.
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The Simplicity of
McLAUTHLIN ELECTRIC DUMB WAITERS
Insures high efficiency, low operating cost and low depreciation.
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Frequency Meters

Built on the induction principle

Westinghouse Type "F" Frequency Meter

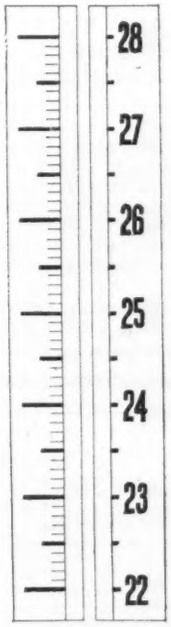
Westinghouse Type "I" Frequency Meter

No moving wires.
No control springs.
Only moving parts are a very light, aluminum disc, shaft and pointer.

Other advantages:

Read directly on scale, like voltmeters.
Correspond in appearance to the other instruments on the board.
No vibrating reeds to age or to confuse switchboard operators.
Indications strictly independent of voltage variations.
Very low price.

Write for full particulars



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If every prospective purchaser of a Switchboard knew what we know about Bissell Boards and Bissell Prices, we would get their business.

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They give "quotations on the spot."

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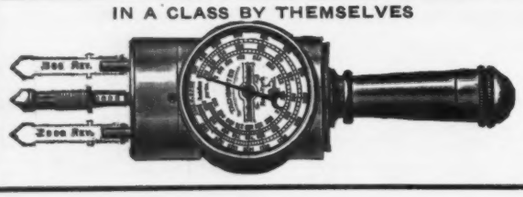

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Portable and Stationary for Low and High Speeds; Indicating or Recording. All are unfailingly accurate. Write for catalogue.

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Accurate, Compact, Inexpensive

VOLTMETERS, AMMETERS
and VOLT-AMMETERS

Send for complete catalog.

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Including Leather Case.

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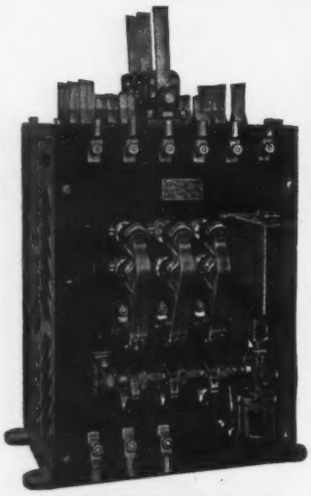
"SCHUREMAN" Elevator Controllers

FOR A. C. MOTORS ARE THE **SAFEST**



15 H. P., 220 V., Type "A. S. F." Elevator Controller for Slip Ring Type Motor, Hand-Cable Control.

Because the Rheostats are operated by solenoids and possess the NO-VOLTAGE RELEASE FEATURE

Write for our new bulletins on A. C. self-starters and elevator controllers embodying this feature.

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100 different sizes, adapted to all kinds of testing and laboratory work. They are light, portable and have a large number of steps. Write for circular No. 1100 which describes them in detail.

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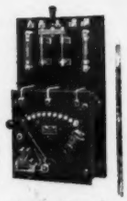
Electric Controlling Devices FOR ALL PURPOSES



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Note, please, the underscored words: "for all purposes." Our standardized controlling devices now exceed 2500 in number, but even this great array of apparatus is insufficient to meet all modern needs. As the use of electricity extends to new fields, as the desire to substitute automatic operation for manual operation increases, the demand for special apparatus becomes more insistent. This demand we are prepared to satisfy.

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The largest plant in the world devoted exclusively to the manufacture of electric-controlling devices

Crane Controller.

will soon be enlarged by a three-story addition. Work on the foundation is now under way. With more space, more men and more machines, we shall be prepared better than ever before to serve you. Competent engineers—specialists in the subject of electric control—are in charge of each of our District Offices. Save time by addressing the office nearest you.

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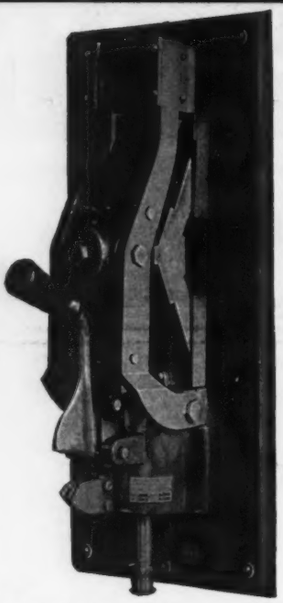
you will not know how well a circuit breaker can be made, or what valuable service it will give.

Condit experience is at your disposal. Use it.



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Manufacturers of Oil Switches and Circuit Breakers

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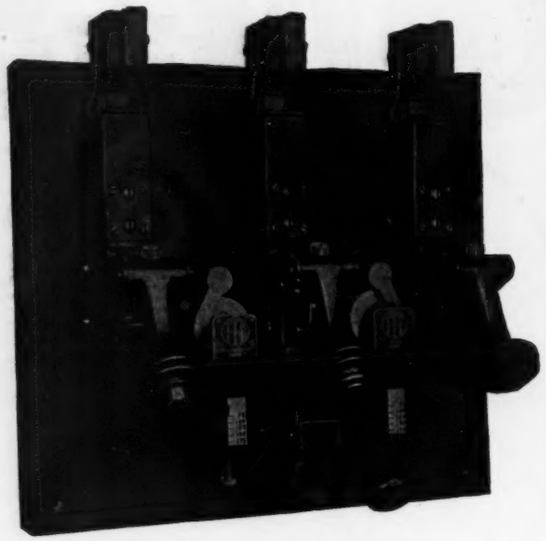

Three-Pole type "W" circuit breaker overload and no voltage, designed for the protection of polyphase motors.
Can also be supplied with "DAL-ITE" (Time Limit) feature.

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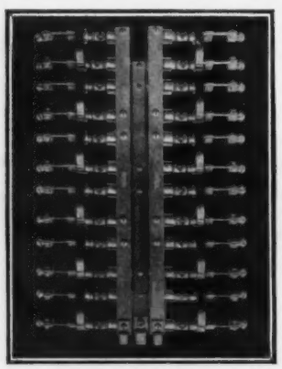
Compact Panelboards and Cabinets

reduce the cost of installation. Our catalog tells how and why, and describes our entire line. Shall we send you a copy?



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Most Engineers admit that the **HORIZONTAL BREAK** with thin knife blade contacts submerged in oil, is the best for **HIGH VOLTAGE SWITCHES**

KELMAN

We accomplish a horizontal break by means of a **PANTOGRAPH MOTION. A DISTINCTIVE FEATURE** which is patented in the **KELMAN OIL SWITCH**

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THEY CANNOT JAR LOOSE

Cat. 762

A step forward in the Rosette Line.

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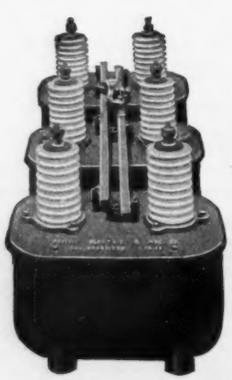

AN OIL SWITCH With Porcelain Insulation Throughout

That is nowhere under tensile or hammering strain—that has puncture and creepage provision for twice its needs—that is quiet at full voltage.

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is an economical tape from every standpoint. A given length of JOMANCO TAPE will do more work—and do it better—than the same yardage of any other tape. As the fabric is tough, close-woven and carefully selected, any piece of any roll of JOMANCO will hold a 37-pound weight without breaking. Our special calendering machines work the composition into every thread of the fabric, making the finished product free from pin holes, thin or lumpy spots and weaknesses.

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has as a base *pure Para rubber* scientifically compounded, so that it never dries out. After application it forms a solid homogeneous mass of rubber—without the aid of heat. You can easily prove this by cutting into a joint made with Phoenix—the layers will not be discernible. A strip of PHOENIX COMPOUND will stretch until it is but half its original width before breaking.

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QUICK-BREAK
FIRE-PROOF
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Approved by Underwriters and N. Y. Fire Dept.

EVERYTHING ELECTRICAL FOR THEATRES

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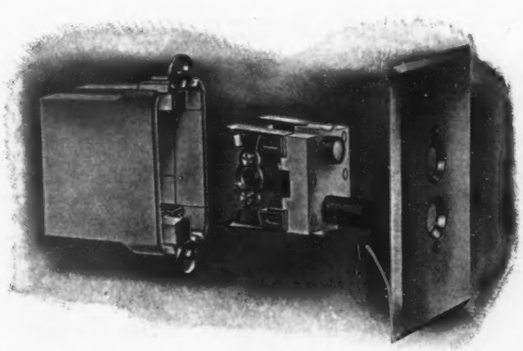

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For ELECTRICAL INSULATION and MECHANICAL PURPOSES

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COLORS: RED, GREY and BLACK. Write for Estimates

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Metropolitan Detachable Switch

The detachable feature makes it the most modern switch on the market. It is the only switch with its mechanism entirely protected by porcelain. Specify them on your work.

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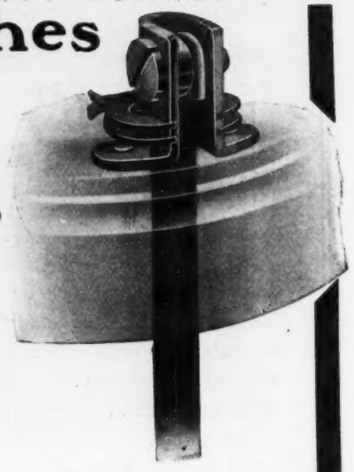
THE COST OF INSTALLING
"Diamond H" Switches



Is less than you now figure
Easiest switch in the world to wire
Notice the binding post
There are other reasons
New Catalog tells them
Your jobber can supply you
If he won't we will

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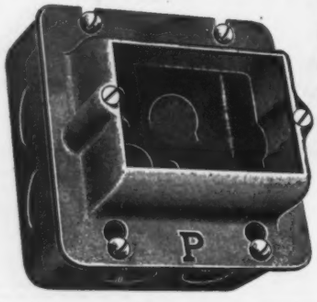

Easy Clean Knock-Outs
Labor-Saving Covers
Perfect in Every Detail
Approved by the Underwriters
Perfect Ground
Coating Does Not Chip Off

Send for Catalogue

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The Contractor Who Uses Bossert Drawn Steel Boxes

knows that he can figure lower on conduit wiring and still offer high-grade work.

A sample will tell you why. Shall we send you one?

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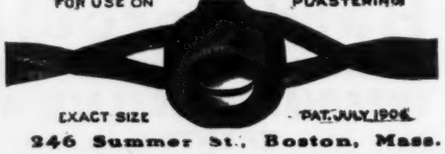
hold the slack, protect the insulation on the wire, reduce trouble hunting, make a good job always and especially where corners are turned.



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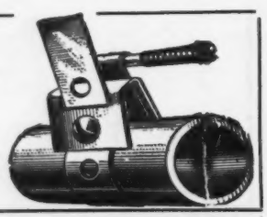
Reduce your stock to three sizes. Fitting from ⅛ to 3 in. pipe. Easily applied. Low in price.



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WILMINGTON FIBRE SPECIALTY COMPANY
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FIBRE

WARD LEONARD

FIELD RHEOSTATS—THE STANDARD OF EXCELLENCE

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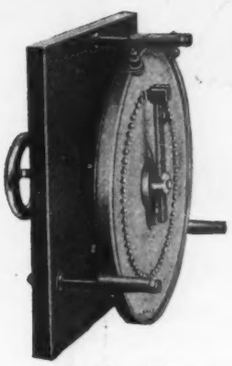


Back of Board Type

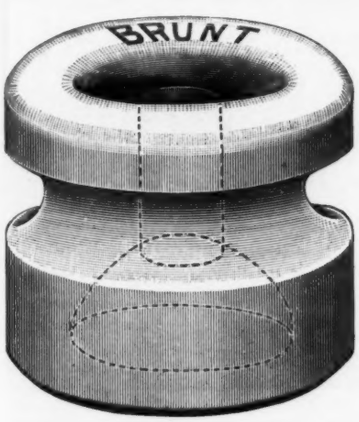
Remote Control Type

Remember this:

The magnitude of this industry concentrated on one thing, admits of a quality of material and accuracy of workmanship at a lower cost to the user than he can hope to attain in his own plant or can purchase elsewhere.

Some users feel tempted to buy inferior copies of "Ward Leonard" rheostats because they are under the impression that the latter are considerably higher in price. *This is a mistake.* Our prices *to-day* are actually *lower* than those of imitation goods. On any basis of design, durability and workmanship there is no comparison.

WARD LEONARD ELECTRIC COMPANY, BRONXVILLE, NEW YORK



A Name Is of Little Worth Unless Backed by a Record

Back of our name is a record of over twenty years of success in making only the highest grade of porcelain. That is why we mould that name in every piece of

Genuine Brunt Porcelain

as a guide to you in your search for the best. If you are a jobber, and are fully alive to your own interest and that of your customers, you will put large quantities of Brunt Porcelain in stock. It is of the highest possible quality, yet costs no more than inferior goods.

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4012 B

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Patented August 6, 1907

These reflectors are made in a great variety of shapes.

If you have not yet made an installation of this type of reflectors, one experiment will convince you of their effectiveness.

Their ornamental beauty is without question.

Gillinder & Sons, Inc.

PHILADELPHIA

SHOW ROOMS:

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Church Lighting

WITH

Frink Reflectors

SATISFIES YOUR CUSTOMERS

MOST contractors for electrical equipment leave their customers to shop around for fixtures. Some others, however, appreciate the necessity of engineering the installation in every detail. These have found the sale of

FRINK REFLECTORS

a profitable auxiliary to their general business. Our reflectors are built on scientific lines of thoroughly first-class material and workmanship. They have received highest awards at the leading expositions and are used by thousands of satisfied customers. We have a line of reflectors for every lighting need and will gladly make recommendations and quotations on receipt of inquiry.

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The Goodwin & Kintz Co.

Station C

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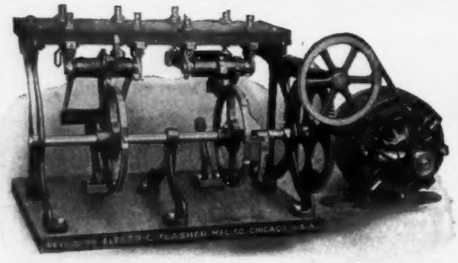

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Simple
Strong
Reliable

Built in all sizes to control one or ten thousand lamps, to produce any imaginable flashing effect.

Write to-day for illustrated matter, prices and discounts.

REYNOLDS ELECTRIC FLASHER MFG. CO.

Largest Flasher Manufacturers in the world

191-193 Fifth Ave., CHICAGO, U. S. A.

THE safest, cheapest and quickest way to build an electric sign, next to buying it from us, is to buy the letters from us.

Haller Sign Works (Inc.)

316 South Clinton St., Chicago

TUNGSTEN lamp machinery

Complete plants. Send for Catalogues.
Premier **Tungsten** lamps.
Pure tungsten is not brittle.
Ours are pure **Tungsten.**

Dwyer Machine Co., Lynn, Mass.

THE MOORE LIGHT

"Comes in Long Vacuum Tubes"

WHITE LIGHT Incomparable for Color Matching.

YELLOW LIGHT Best Illumination for Large Areas.

Send for New Booklet

MOORE ELECTRICAL CO.

NEWARK, N. J.

The More Special Your Requirements in special porcelain parts, the better we can satisfy you. We do good work quickly. Write for prices.

The Colonial Sign & Insulator Co., Akron, Ohio

Tungsten Specialties

OPALUX Reflectors

Opalux is being recognized as the leader in modern reflectors and shades. Opalux augments the efficiency of the Tungsten Lamp and at the same time eliminates the possibility of breakage when cleaning the shades.

Complete Engineering data furnished on request.

Tungstolite Fixtures

In conjunction with Tungsten Lamps, this fixture furnishes an effective weapon for fighting gas arc competition in store, office and shop lighting.

Each Tungstolite is packed in a separate box so that it can be reshipped without danger of breakage. Cost low, efficiencies high, shipments quick.

Central Electric Company,

264-266-268-270
Fifth Avenue
CHICAGO

Catalog No. 903

List Price $0.25

Write for Quantity Discounts.

Benjamin Electric Mfg. Co.
42 W. Jackson Blvd., Chicago

Artistic Lighting

has been our specialty for years.

Our new catalog No. 7 illustrates many of our new designs. Write for it.

The Morreau Gas Fixture Mfg. Co.
Cleveland Ohio

Wireless Sign Letters, Original Designs and Novelties in Sign Work

The A & W Electric Sign Co.
Originators, Designers and Builders of Electric Signs and Displays
CLEVELAND, OHIO

Best Renewed Lamps
Nine Cents
Boston Incandescent Lamp Co. Danvers, Mass.

WE give notice that we hold an exclusive license to make, use and sell Miniature and Candelabra Bases under United States Patent No. 760,065. We will prosecute any parties making or using Miniature or Candelabra Lamps upon which are used infringing Bases.

PROVIDENCE GAS BURNER CO.
Manufacturers of Incandescent Lamp Bases
PROVIDENCE, R. I.

BRYAN-MARSH INCANDESCENT LAMPS

A LAMP FOR EVERY SERVICE. BEST SERVICE FROM EVERY LAMP.

TUNGSTENS
TANTALUMS
GEMS
"IMPERIAL CARBONS"
TUNGSTEN & CARBON
MINIATURES

BRYAN-MARSH COMPANY
CHICAGO, ILL.
CENTRAL FALLS, R.I.
NEW YORK, MINNEAPOLIS,
CINCINNATI, DENVER,
OAKLAND.

18 Watt, 100-120-V. Smallest Unit.

"Just" Tungsten (Wolfram) Lamp

"Made in Germany"

"LICENSED"

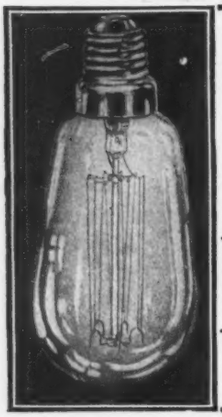
18-500 Watt 100-250 Volt

Burning in **any** position

PRICES AND DISCOUNTS THE SAME AS THE DOMESTIC LAMP

Sole Representatives for the U. S.

The Electrical Accessaries Co., 1135 Broadway, New York



"WOLFRAM"
THE BEST IMPORTED
TUNGSTEN
HIGH-EFFICIENCY
LAMPS

P. H. KLEIN, Jr. CO.
110 Liberty St. NEW YORK

Can be safely shipped even in small lots

HY-LO

TUNGSTEN
TURNDOWN LAMP

35 Watt—27 C. P.—Small Filament 8 Watt (Carbon)

Write for descriptive matter and prices

Made by

ECONOMICAL ELECTRIC LAMP CO.
25 West Broadway New York

Save your current; save your eyes; save your lamps with the

DIM-A-LITE Turn-down Socket

A Portable Attachment for dimming a single incandescent lamp.

A touch changes light from "full" to "medium," "way-down" or "out"—**four changes.**

Will not break, burn out or wear out. Built for every-day use and hard wear. Fully guaranteed. Good for carbon, tantalum or tungsten lamps.

By mail $1.00 Agents wanted
Write for trade discount

Charles Wirt & Co.
Philadelphia

Now Is the Time to Buy

Renewed Electric Lamps made by a factory that is NOT IN THE TRUST. We do not etch our lamps "RENEWED," neither do we hold you to re-sale schedule of prices, both of which conditions are required by the Trust Renew Factories. We closed contracts for over two million burnt-out lamps for 1908, and CAN FILL ORDERS PROMPTLY.

Write for Prices and Trust Cartoons.

Hill-Wright Electric Co.
105-107 Reade St., New York City

PROTECTION

PROTECT your Tungsten Lamps with a

TUNGSTEN LIFE-SAVER

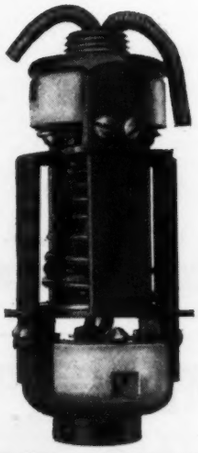
Positively Prevents Injurious Shocks from Vibration

TUNGSTEN LIFE-SAVER is a new and thoroughly practical device for absorbing and effectually annulling the shock of vibration. It is made to fit any standard fixture—it is readily installed and requires no repairs. When installed in offices or stores it may be entirely concealed by ceiling canopy.
TUNGSTEN LIFE-SAVERS are packed in separate cartons with full instructions.

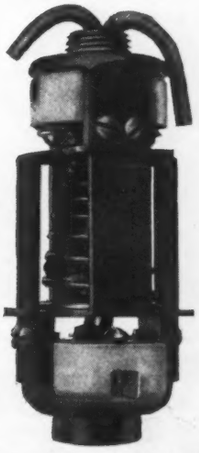
PROTECTION

A Complete Proposition for Shop and Factory Lighting

A NEW FIELD OPENED FOR TUNGSTEN LAMPS


TUNGSTEN LIFE-SAVER
(Half-Size)

FOUR LIGHT


TUNGSTEN L FE-SAVER
(Half-Size)

TUNGSTEN SHOP CLUSTER

PROTECTION

An inexpensive cluster made of steel, with plain black finish. Equipped with 18-inch steel—Porcelain Enameled Shade and Tungsten Life-Saver.
Light Distributing Cone a Special Feature.

PROTECTION

Manufactured by

American Arc Lamp Company

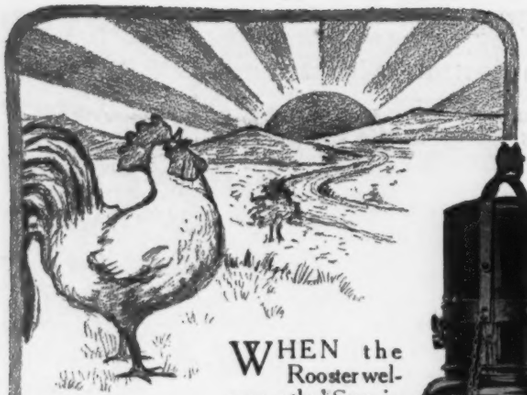
SPECIALTIES DEPARTMENT

KALAMAZOO, MICH.

BULLETINS:
No. 40 Tungsten Life-Saver
No. 42 Tungsten Shop Cluster

FOR SALE BY
JOBBERS
DEALERS

WRITE FOR PRICES AND DISCOUNTS



WHEN the Rooster welcomes the *Sun* in the early morning

AUROLA

Flaming Arc Lamps give way to their only rival in power of light.

In reliability of service, maintenance of candle power and economy they have no superior.

Write for AUROLA Literature.

CHAS. L. KIEWERT CO.

NEW YORK: 39 Cortlandt Street

MILWAUKEE: 114 Huron Street

The Heany Tungsten Lamp Burns In Any Position

PATENTS PENDING

With equally efficient service.

It is the most perfect lamp on the market.

Will stand rough handling without breakage or displacement of filament.

Has twice the life of a carbon lamp, and gives a perfect white light without deterioration in quality. Saves 75 per cent. in current.

Write for prices.

THE HEANY LAMP CO.

25 Broad Street New York

POLAR FLAMING ARC LAMPS

Burn 20 Hours on One Trim

Adopted by many of the Largest Railway Systems in the United States

IN USE BY MANY OF THE LARGEST STEEL PLANTS, AUTOMOBILE FACTORIES, DOCK COMPANIES, THEATRES, AMUSEMENT PARKS, AND OTHER INDUSTRIAL PLANTS THROUGHOUT THE UNITED STATES

Southwestern Agency: T. P. GLEESON, Syndicate Trust Bldg., ST. LOUIS, MO.

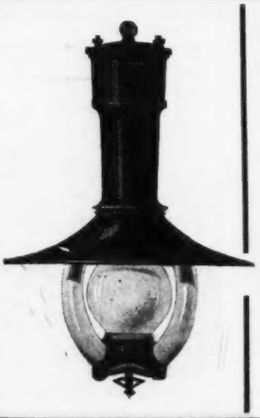
FOX BROS. & CO., 126-130 Lafayette Street, NEW YORK

Western Agent: F. B. BADT & CO., 1504 Monadnock Block CHICAGO ILL.

A Revolution in Flaming Arcs

as radical a change as was the enclosed arc over the old open arc.

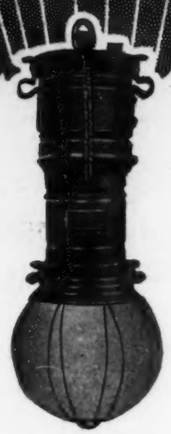
The A-B Regenerative Flame Arc Lamp



Vertical carbons, burning 70 hours per trim. Lower hemispherical candle power 20% greater than in other flaming arcs, expense of attendance about 80% less, cost of carbon much lower. 70v. across arc, consumption 5 to 5½ amp. D.C. and 7 amp. A.C. Perfect distribution. Operate singly on 110v. or 2 across 220v. Write for Bulletin No. 79.

The Adams-Bagnall Electric Co. Cleveland, O. New York Chicago

GRANT



Gravity feed, simplest and most reliable.
Used by the largest industrial corporations and merchants—a big success everywhere. 10-hr. and 17-hr., 3000 and 4000 c.p.

FLAMING ARC LAMP

German-American Electric Co., 110 West 14th Street New York

Grant Flaming Arc Lamp Co., 560 Pacific Bldg., San Fran., Cal.
Grant Flaming Arc Lamp Co., Old Colony Bldg., Chicago, Ill.
L. C. Blundin & Co., 40 S. 16th St., Phila., Pa.
Harry I Wood Co., 520 W. Main St., Louisville, Ky.
Martin Electric Co., 90 Verona St., Brooklyn, N.Y.
Grant Electric Co., 3411 Olive St., St. Louis, Mo.

The Sun's Silent Partner

The next best thing to day light is the mellow, color-true, steady, shadow-free, evenly distributed illumination produced by the

STAVE Flaming Arc Lamp

LITTLE BROTHER OF THE SUN

Unquestionably the ideal for commercial illumination of large areas, indoors or outdoors. There are no experimental features in the Stave. It operates perfectly on 25 cycle A. C. or high tension D. C. and is fully guaranteed for a year. Let us go into details.

Stave Electrical Company

Main Office: 27 West 27th St., New York

Chicago: 1101 Monadnock Bldg. Davenport: 506 Lane Bldg. Boston: 516 Atlantic Ave.
Buffalo: 15 Terrace Providence: 305 Bannigan Bldg. Cleveland: New England Bldg.
Philadelphia, 1406 Vine St. Pittsburg: 407 Fourth Ave. Atlanta: Fourth Nat'l Bank Bldg.
Branches: Detroit St. Louis Louisville Newport News, Va.

The Reasons Why Prices of Flaming Carbons Are High

The duty at present for this kind of carbons is $18.00 per 1000 pairs, and if the new rate advocated by the Carbon Trust and accepted by the Finance Committee should be enforced, the duty will even be $26.00 per 1000 pairs.

This is a hardship on the consumers because the domestic article cannot be used satisfactorily in Flaming Arc Lamps, and never will be, inasmuch as the process of manufacturing is a secret only known by the manufacturer of the "Excello" Flaming Carbons.

It has been demonstrated and is acknowledged by all users of Flaming Arc Lamps, that the "Excello" Flaming Carbons are the only carbons which give satisfaction in all types of flaming lamps.

THE "EXCELLO" CARBONS ARE SOLELY IMPORTED BY

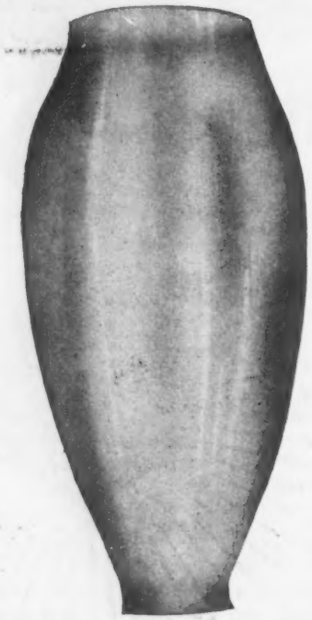
HUGO REISINGER, 11 Broadway, New York

Beware of using imitations and cheap grades of carbons to the detriment of your lamp.

HUGO REISINGER, 11 Broadway, New York

If you don't specify "Phoenix Globes" you're extravagant

Inferior globes waste light and don't last as long.

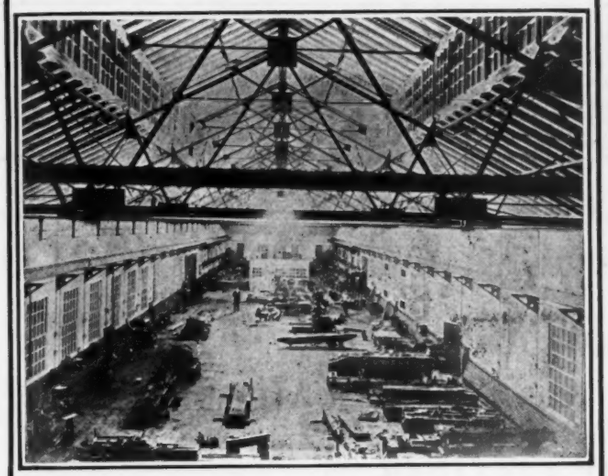


Phoenix Inners

never blacken because they do not soften, thus preventing carbon particles from adhering to them. Their perfect temper makes them long lived. Special proposition awaits you.

The Phoenix Glass Co.

New York **Pittsburg** **Chicago**



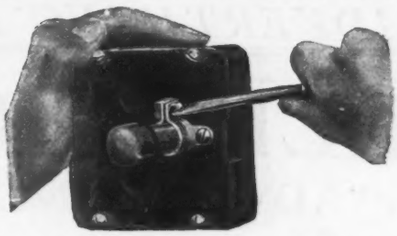
THIS is the machine shop of the Bettendorf Axle Co., Bettendorf, Iowa, after replacing 15 enclosed arcs by 4 Excellos.

Result—More and better light at less cost. Saving in power—10⅝ H.P.—this is the engineer's figure.

The Excello Arc Lamp Company

New York, 30-32 East 20th Street
Chicago, 118 W. Jackson Boulevard

Federal Outlet Box Clamp



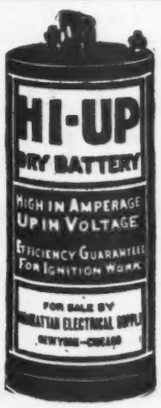
A Device for Fastening Ceiling Outlet Boxes Firmly to the Dummy or Gas Pipe

Saves from 10 to 15 minutes' labor on every box installed.
Holds outlet box firmly at right angles to gas pipe, preventing swaying fixtures from breaking ceiling plaster.
Closes up open space around pipe, avoiding danger of fire in case of short circuit or loose contact.
No threading of dummy for several inches from end of pipe necessary.
Approved by Underwriters' Laboratories.

Write for Bulletin No. 809

Federal Electric Company
Lake and Desplaines Street, Chicago

Samson Spot Waterproofed Cord
Is the standard for Arc Lamp and Trolley Cord. The Colored Spot stands for extra quality material and skilled workmanship.
SAMSON CORDAGE WORKS, Boston, Mass.



Guaranteed to stand up equal to any Dry Battery on the market for ignition work. Three sizes.

Our guarantee means we will CREDIT account, REPLACE batteries or REFUND amount paid for the batteries, including transportation charges, if they do not prove satisfactory.

Manhattan Electrical Supply Co.
17 Park Place, 110 West 42d Street, NEW YORK
188 Fifth Ave., CHICAGO

Engineers and bankers should study Preston Player's

Notes on Hydroelectric Developments

and learn the factors that enter into the planning of successful plants. It is illustrated and has 70 pages and will be sent anywhere for One Dollar by the

McGraw Publishing Company
239 West 39th Srreet
NEW YORK 3

Copyright, 1905, by the J. L. Mott Iron Works

Arc Lamp Poles

IRON ARCS
LAMP POLES
BRACKETS
ELECTROLIERS
FIRE ALARM POSTS
TEST POSTS
ETC.

Catalogues and Price lists on application

THE J. L. MOTT IRON WORKS
5th Ave. and 17th St.
NEW YORK

Control of Temperature

PELOUZE "UNIVERSAL" IRON

When Not in Use

"The iron of highest efficiency and endurance"

Guaranteed to do perfect work and save from 20 to 50% in current over other irons.
The heating element is wound in a flat plane and operates on bottom of iron only. No waste of current.
The economical iron. Everyone can afford to use it.
Also control of temperature at the iron.

WRITE FOR PRICES AND DETAILS

PELOUZE ELECTRIC HEATER CO.
403-413 Ohio St., Chicago

ADVERTISING IN

ELECTRICAL WORLD

is "ADVERTISING THROUGHOUT THE WORLD"

Read the letter opposite from Mr. George Hearn, Pres. of the Ricker Mfg. Co.

NOTE that this company received

over 2,000 replies in less than six months from a quarter-page weekly advertisement. . . . . .

Also note the wide range of the circulation of this paper as indicated by the various countries from which replies were received.

Isn't this convincing proof that

ELECTRICAL WORLD
GOES ALL OVER THE WORLD
and that its readers use its advertising pages when making purchases?

CUTS AND COPY

for the

JULY EXPORT ISSUE

wanted not later than

JUNE 28

ELECTRICAL WORLD

GEORGE HEARN, PRES. AND TREAS. FRANK R. ASHTON, SUPERINTENDENT RICHARD J. COOPER, SECRETARY

THE RICKER MANUFACTURING CO.

239 NORTH WATER STREET

ROCHESTER PHONE 3776
BELL PHONE 2766 MAIN

ROCHESTER, N. Y., June 10, 1909.

Electrical World,

114 Liberty Street,

New York City.

Mr. Jas. M. Wakeman, Vice-president.

Dear Sir:-

Permit us to congratulate you upon the Convention number of your paper. It may be of interest for you to know, that since Jan. 1st last, when we started advertising in your paper, we have been very much gratified with the results, which were beyond our expections.

In response to our advertising the Rochester Oil Fuse Box for AC Distribution, and the Rochester Meter & Service Box for prevention of theft of current, we nave received over 2,000 inquiries from every quarter of the North American continent, Great Britain, Denmark, Japan, and other places, which is of sufficient evidence to us, that in advertising in your paper, we are advertising throughout the world.

Yours very truly,

The Ricker Manufacturing Co.

Geo. Hearn

Pres.

Attention is invited to the one horse-power vertical motor-driven *Spencer Turbine Cleaner Company's* outfit, which has a large sale for small and medium-sized residences. It will be noticed that this machine is neither a portable cleaner nor a toy. It consists of a vertical air turbine which acts as a powerful air pump to the shaft of which is coupled the armature shaft of an electric motor. There are consequently no belts or gears, nor no resultant noise and trouble

This machine is designed to be installed in the basement of a residence with a 2-inch riser pipe going up through the building and an inlet valve on each floor. Thorough cleaning is guaranteed at the end of a 50-foot hose when connected to any inlet valve in the vacuum piping system in the house. This permits all the dust and dirt to be carried down and deposited in the dirt-receiving pans in the machine, while the foul air and germs resultant from any cleaning by suction are carried to a chimney or sewer by a pipe from the lower opening in the turbine. It will be appreciated that this is a far more sanitary method than to exhaust the germladen air directly back into the room that is being cleaned.

We manufacture and can ship reasonably prompt a complete line of vertical, direct-driven turbine cleaners from one horse-power to thirty horse-power, inclusive, and you can easily find by investigation that we build the most efficient, simple and successful vacuum cleaning apparatus on the market.

Vacuum cleaning apparatus has come to stay, and the best machine is going to win out, the same as in any other business. We can convince you that we have the best machine if you are willing to look into the matter.

Over ninety per cent. of the machines that we manufacture are equipped with electric motors. This means that we get one profit when we sell the apparatus, while the central station gets a profit twelve times yearly. Under the circumstances you may be interested in our mutual-benefit proposition. If so, write us.

The Spencer Turbine Cleaner Co.

Principal Office and Factory:
Hartford, Conn.

New York Office: Metropolitan Tower, No. 1 Madison Ave.

AGENCIES IN ALL LARGE CITIES

The "IMPERIAL"

A Portable Vacuum Cleaning Machine
combining efficiency, practicability and economy.
Can be attached to any electric light socket.

EFFICIENT Because it thoroughly accomplishes its purpose.

PRACTICAL Because of its simplicity and compactness.

ECONOMICAL Because of its minimum cost of maintenance and operation.

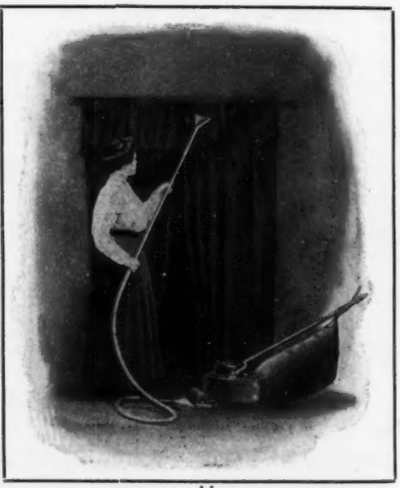
A Dividend Payer for Central Stations

Growing concerns and responsible parties wanted for agents. Exclusive territory given. Send for Catalogue and Particulars.

Price $100, Complete

EMPIRE VACUUM COMPANY
112 West 30th Street, New York

Make lamp-sockets work by day



as well as by night.

Hoover's Electric Suction Sweeper

will do this for you. It's a simple but thoroughly useful machine. It sweeps by power and cleans by suction—plugs into any lamp socket. It's simple enough for a woman to operate, light enough for her to carry about. It sells at a surprisingly low figure, but leaves a surprisingly good profit for central station or agent. Sent on 15 days' trial. Get one yourself and try it out.

The ELECTRIC SUCTION SWEEPER CO.
New Berlin, Ohio

These Trade Marks Imply Established Standards of Quality

"CONSULT THE MAP"

VICTOR
FANS, TAPE, CORD

DYNAMOS-MOTORS
WESTERN ELECTRIC COMPANY
CABLE-TELEPHONES-SUPPLIES

Hawthorn
MOTORS, GENERATORS, ARC LAMPS, FANS, IGNITION BATTERIES, BELLS

"WRITE OUR NEAREST HOUSE"

HABIRSHAW
CABLES & CORES.
RUBBER COVERED WIRES AND CABLES

AMERICAN CROSS-ARM CO.
ASK YOUR DEALER FOR
WALWORTH NEVILLE
CROSS-ARMS
CHICAGO
STANDARD AND SPECIAL CROSS-ARMS

THOMAS QUALITY
RELIABILITY
THOMAS PORCELAINS

BLACK CORE
PARAC
RUBBER WIRES
"PHILLIPS" INSULATED WIRES AND CABLES

TRADE
ELECTROSE
MARK
REG. U.S. PAT. OFF. & FOREIGN COUNTRIES.
INSULATION

WEATHER-PROOF
TRADE MARK
"O.K."
LINE AND HOUSE WIRES
"PHILLIPS" INSULATED WIRES AND CABLES

Complete Stocks of All These Standard Lines Are

CARRIED BY THE

WESTERN ELECTRIC COMPANY

Manufacturers and Suppliers of All Apparatus and Equipment used in the Construction, Operation and Maintenance of Telephone Plants and Central Stations

EASTERN	CENTRAL	WESTERN	PACIFIC
New York	Chicago	Saint Louis	San Francisco
Philadelphia	Indianapolis	Kansas City	Los Angeles
Boston	Cincinnati	Denver	Seattle
Pittsburg	Minneapolis	Dallas	Salt Lake City
Atlanta		Omaha	

Northern Electric and Manufacturing Co., Ltd., Montreal and Winnipeg

14 YEARS OF CONSTANT

and Successful Efforts to Improve Has Made Standard of the Market. The High Standard by Which Others Are Judged.

SIMPLEX EQUALITY

SIMPLEX ELECTRIC HEATING DEVICES

represent not a record of changes from one form of construction to another, but on the contrary a constant improvement of a single form. This form was selected because it was scientifically correct and the history of electric heating has fully proved this fact. Buy goods with a record for quality—not promises.

SIMPLEX ELECTRIC HEATING CO.
CAMBRIDGE, MASS.

Monadnock Block, Chicago, Ill.
612 Howard St., San Francisco

WRITE FOR BOOKLET "G" NOW

Entering Wedges—30

YOU CAN SOLDER TILL YOUR HANDS DROP OFF

But a Vulcan Electric Soldering Tool will go on everlastingly giving the same uniform results, hard service or easy service. Some people get the idea that they will do for a time, then give out. They don't know because they haven't tried. We especially recommend Vulcans in continuous daily service to do hard work, to do it well every minute of the time, and you can start now and solder until Labor Day without stopping and then you'll write a testimonial for us.

LET US SEND YOU CUSTOMERS' FIGURES PROVING SAVING

They prove ELECTRICITY CHEAPER THAN GAS. Understand that these are not isolated examples,—nor that they are the best figures we can show. We can beat them. These figures represent the average. Vulcans apply to all soldering operations; we are soldering specialists and we make a range of shapes and sizes covering service in scores of industries. We have hundreds of customers who use them, customers who use hundreds. One firm uses over one thousand. Vulcans replace all other methods and appliances because they do the work easier, better, vastly cheaper.

That's the simple way of putting it and it's the true way. Sold through Dealers and Central Stations.

VULCAN ELECTRIC HEATING CO.

TRADE VULCAN MARK

73 W. Jackson Blvd.
CHICAGO 78

STRONG AND DURABLE GEARS

the result of years of experience operate the

"Eck Hurricane"
OSCILLATING FAN

ECK DYNAMO and MOTOR CO.
BELLEVILLE, N. J.
19 Murray St., New York City

More Customers and More Business for the supply dealer or Central Station man first in his territory with the Del Electric Curling Iron. Prices and particulars are yours for a word. Write.

Del Sales Company, 250 Dearborn St., Chicago.

Rose Polytechnic Institute, Terre Haute, Ind.

A College of Engineering. Courses in Mechanical, Electrical, Civil and Chemical Engineering and Architecture. Extensive Shops, well equipped Laboratories in all departments. Expenses low. Twenty-sixth year. For Catalogue containing full information and professional register of alumni, address—C. L. MEES, President.

JUST ONE THING MORE

WE have no desire to prolong a newspaper controversy with the New York agents of foreign carbon factories, especially since they can only, small-boy-like, hide behind a tree and dodge the issue every time we correct their misstatements.

We are willing to leave the matter of our sincerity to the thousands of carbon users who have benefited millions of dollars by American competition, and we have sufficient confidence in the friends of "Columbia" carbons to believe they will not be influenced by the malicious and libelous efforts of the European factories to regain control of the American market.

But we want to again deny most emphatically that our company will advance the price of arc light carbons regardless of how the tariff matter is settled, and should we be permitted to continue this branch of our business, we pledge ourselves to further voluntary reductions whenever our costs will permit, as has been our custom in the past.

National Carbon Company

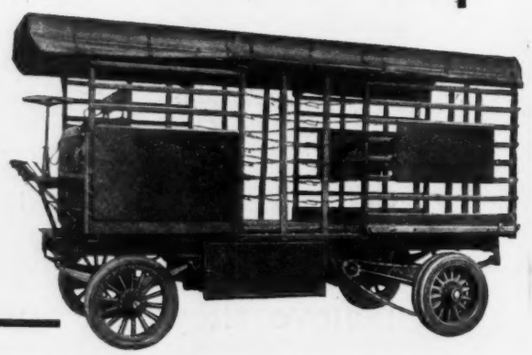
CLEVELAND, OHIO

The Profitable Load

for Central Stations is the load which reduces the prominence of the peaks.

Electric vehicles are ideal for this purpose—wide awake merchants are easily convinced of their superior convenience and economy, and they are charged during the time when other loads are light.

We are the largest manufacturers of electric commercial vehicles in the world. Write for our catalog.



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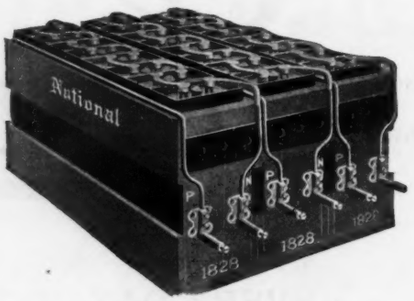

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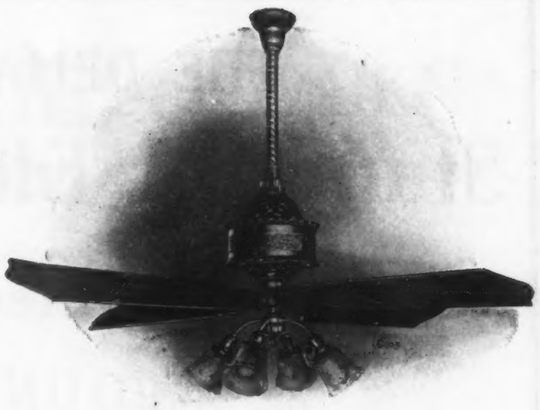

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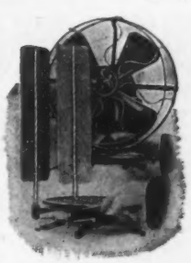

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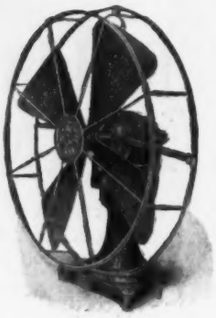

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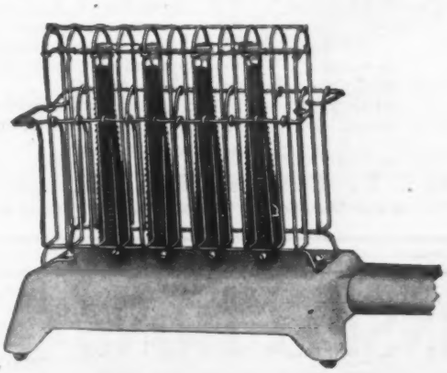

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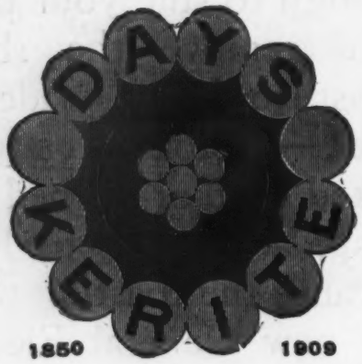

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Roebling's Sons Co., J. A.
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General Electric Co.
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Sears, Henry D.

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RECTIFIERS.
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Metropolitan Elec. Stage Ltg. Co.

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Heck, Louis.

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Wirt & Co., Chas.

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Driver-Harris Wire Co.
Electrical Alloy Co.
Prosser & Son, Thos.

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(*Continued on page 77.*)

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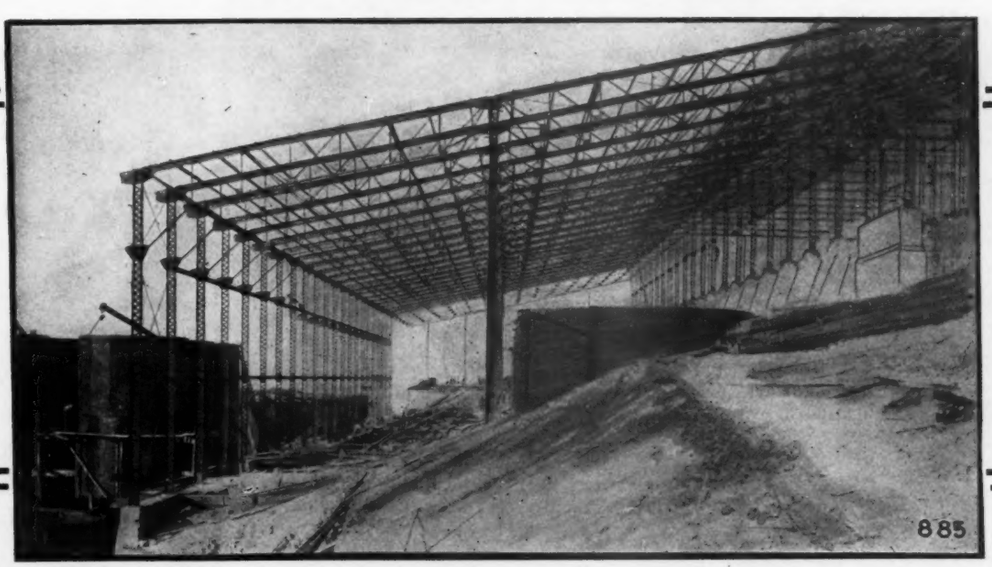

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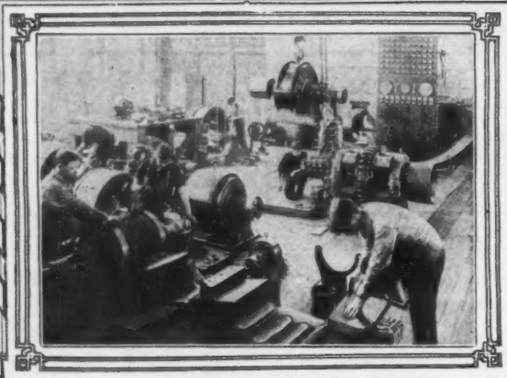

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Bargains for Sale

60-Cycle Alternators

K.W.		Speed
1 40	Westinghouse	900
1 45	Westinghouse	900
1 50	Westinghouse, 2-phase	900
1 60	Westinghouse	900
1 60	Westinghouse, 2-phase	900
1 60	Gen. Elec., A.S.	900
1 75	Ft. Wayne, W.A.L.	600
1 100	Gen. Elec., 550 volts, A.P., 3-phase	900
2 100	Gen. Elec., A.T., 3-phase	900
1 110	Ft. Wayne, 3-phase, revolving field, direct-con. to Ideal engine	257
1 120	Gen. Elec., A.S., 120	900
2 150	Westinghouse, 2-phase	600
1 180	Westinghouse, 3-phase	514
1 200	Westinghouse, 3-phase, revolv. field, 440 volts.	600
2 300	Gen. Elec., A.S.B., revolving field	450
1 300	Gen. Elec., A. T., 3-phase	720
1 400	Westinghouse, 3-phase	400

25-Cycle Alternators

K.W.		Speed
1 85	Westinghouse, 3-phase, revolving field, 440 volts	600
1 130	Westinghouse, 3-phase, 440 volts, revolving field type	500
2 275	Westinghouse, 3-phase, revolving field, 6600 volts	375
1 250	Westinghouse, rotary converter, 550-600 volts, direct and 3-phase, 25-cycle, alternating	500
2 440	Westinghouse, 3-phase, revolving field, 440 volts	300

125-133 Cycle Alternators

K.W.		Speed
1 30	National, comp., toothed armature	1500
2 60	Gen. Elec., A. 60	1500
2 60	Gen. Elec., A. S.	1500
1 60	Westinghouse	1050
1 70	T-H., A. 70	1070
1 75	Ft. Wayne, W.A.	1050
3 90	Gen. Elec., A. S.	1250
1 90	Westinghouse, slotted armature	1143
1 100	Ft. Wayne, Type W. A. L.	1050
2 120	Gen. Elec., A. 120	1070
1 120	Westinghouse	1375

Arc Machines

K.W.		Speed
2 50	lt. T-H., 9.6 amp., ring armit	820
1 100	lt. 9.6 amp., Ft. Wayne Wood, No. 9A, self-oiler	800
1 125	lt. 9.6 amp., Brush No. 11, with oil regulator	480
2 150	lt. 9.6 amp., Brush No. 13A, 4-circuit, with oil regulator	500

M. P. 250-Volt D. C Comp Generators

K.W.		Speed
1 8	Fairbanks-Morse, direct con. to Ames engine	375
1 12½	Milwaukee	850
1 12½	Northern	900
1 13	Crocker-Wheeler	950
1 13½	Gen. Elec.	900
1 15	Siemens & Halske.	1050
1 15	West'n Elec., M. P.	700
1 15½	Card, M. P.	800
1 17½	Crocker-Wheeler	1400
1 17½	Northern	1100
1 17½	Bullock	800
1 20	Siemens & Halske.	1100
1 20	Eddy, M. P.	800
1 20	Commercial	750
1 20	Bullock	900
1 20	Bullock	675
1 20	C. & C. comp., direct-con. to Chandler-Taylor engine	320
1 25	Westinghouse	600
1 30	Bernard, M. P.	575
1 30	Bullock	850
1 35	Bullock	675
1 45	Westinghouse	675
1 60	Siemens & Halske, Churchward type.	550
1 60	C. & C.	525
1 60	Milwaukee	550
1 75	Westinghouse	600
1 75	Ft. Wayne	500
2 100	Ft. Wayne	550
1 150	Ft. Wayne, 6 pole.	500
1 100	Jenny, direct con. to Alfree engine	250

550-Volt M. P. Comp Generators

K.W.		Speed
1 15	Sprague-Lundell	1200
3 22½	Westinghouse	975
1 25	Triumph, M. P.	950
2 30	Westinghouse	900
1 55	Gen. Elec.	950
1 100	Gen. Elec., M.P. 4.	650
1 120	West'h'g'se, 4 pole.	625
1 150	West'h'g'se, 6 pole.	550
1 200	West'h'g'se, 6 pole.	510
2 500	West'g'h'se, 6 pole.	350
1 500	Westinghouse	320

550-Volt Railway Motor

H.P.	
62 30	H.P. Walker, type 33 S, brand new, with gears and gear cases, 3¾ or 4-in. axles, ratio 14-67. Special bargain

M P. 125-Volt D. C. Comp Generators

Lights.		Speed
1 50	Browning	850
2 75	Northern	1100
2 100	Northern	1100
2 125	Triumph	1400
1 125	Westinghouse, M.P.	1200
1 135	Crocker-Wheeler	1300
1 150	Aaron, 8½ K.W.	1200
1 150	Peerless, M.P.	1450
3 150	Cincinnati	1100
1 150	Robbins & Myers.	1250
1 150	Jantz & Leist.	1150
1 180	Amer. Eng. Co.	1350
1 180	Robbins & Myers.	975
1 200	Siemens & Halske.	1280
1 210	Western Elec.	1650
2 210	Milwaukee	1250
1 210	Sturtevant	1000
1 210	Westinghouse	1200
3 210	Gen. Elec., C.E.	1200
1 225	Nat'l M.P.	1350
1 225	Ft. Wayne.	1450
1 225	Gen. Elec., 13½ K.W.	850
1 270	Northern	1125
1 270	Westinghouse	1150
1 270	Bullock, M.P.	1050
1 270	National, M.P.	625
1 300	Milwaukee, M.P.	750
1 325	Amer. Eng. Co.	850
1 350	Sprague-Lundell	875
1 350	Fisher	850
1 350	Peerless	1000
1 350	Ft. Wayne.	1200
1 400	Crocker-Wheeler	850
1 450	Quaker City	1000
1 540	Northern, M.P., 30 K.W., comp., dir. con. Erie Ball engine.	350
1 600	Card, M.P.	750
2 600	Gen. Elec., C.L.	1050
1 650	Westinghouse	900
1 650	Amer. Eng. Co.	700
1 700	Northern	825
1 800	Westinghouse, M.P.	850
1 800	Fisher, M.P.	685
1 900	Northern	825
1 1000	National, M.P.	950
1 1000	Western Elec.	450
1 1350	Bullock	850
1 1350	Gen. Elec., 75 K.W., d. c. to Ames comp. engine	270
2 1800	Eddy, 100 K.W.	650
2 1800	Triumph	700
1 1800	Gen. Elec., 100 K.W., 3-wire unit.	375
1 2000	Gen. Elec., 120 K.W., comp., d.c. to Ideal engine	250
1 2500	Western Elec., 150 K.W., new, comp., d. c. to Ball & Wood engine	250

250-Volt D.C. Motors

H.P.		Speed
19	¾ West. Elec.	1500
1	¾ Ft. Wayne, M.P.	1500
2	¾ Westinghouse	1300
3	1 West. Elec.	2400
1	1 Watson, M.P., vertical	900
1	1¼ Western Elec.	780
1	1½ Crocker-Wheeler	1200
1	1½ Gen. Elec., C.E.	800
1	2 Ft. Wayne, M.P.	1100
1	2 Northern, vertical.	550
1	2½ Browning	1920
1	2½ Northern, M.P.	1500
1	3 Triumph	1200
1	4 Crocker-Wheeler	1300
1	4 Westinghouse	1175
1	5 Robbins & Myers	925
1	5 Gen. Elec.	675
1	7½ Aaron, M.P.	1200
1	7½ Card, M.P.	775
3	7½ Northern, M.P.	1500
1	7½ Roth, M.P.	860
1	7½ Commercial, M.P.	540
1	10 Rockford, encl.	1100
1	10 Storey, encl., crane	600
1	10 Sturtevant	340
2	10 Northern, M.P.	800
1	12 Barrett, M.P.	1400
1	13 Burke, M.P.	650
1	15 Thresher	760
1	15 Milwaukee, M.P.	700
1	15 Gen. Elec., formH.	800
1	15 Northern, M.P.	725
3	15 Roth, M.P.	775
1	15 Crocker-Wheeler	800
1	15 Northern, M.P.	1200
1	15 Gen. Elec., C.Q.	1000
1	15 Gen. Elec., C.Q.	625
1	18 Siemens & Halske	950
1	18 West. Elec.	650
1	20 Sprague	1100
1	20 Willey, M.P.	750
1	20 Aaron, M.P.	750
1	20 Card, M.P.	750
1	20 Gibbs, M.P.	600
1	20 Crocker-Wheeler	1250
1	20 Gen. Elec., M.P.	950
1	20 Northern, M.P.	950
1	25 Thomson-Houston	1300
1	25 Siemens & Halske.	970
1	25 Bullock, M.P.	1400
1	25 Eddy, M.P.	725
1	25 Commercial, M.P.	650
2	25 Electron, M.P.	380
6	30 Walker, series, railway type	450–90
1	30 Westinghouse	950
5	30 Westinghouse	975
1	35 Bernard, M.P.	525
1	35 Bullock	750
1	40 Bullock	600
2	50 Electron, M.P.	800
1	40 Westinghouse, M.P.	360
1	75 Siemens & Halske, 6-pole	500
1	75 C. & C., 6-pole.	450
1	75 Milwaukee, 6-pole.	475
1	100 Westinghouse, M.P.	700

500-Volt D.C. Motors

H.P.		Speed
1	1½ Crocker-Wheeler	1550
1	2 Holtzer-Cabot	1225
1	2 Gen. Elec., C.E.	1200
1	2½ Holtzer-Cabot	1450
1	2½ Browning	1390
1	3 Ft. Wayne, M.P.	2200
1	3 Gen. Elec., C.E.	1800
1	4½ Aaron, M.P.	1100
1	5 Barriett, M.P.	1050
1	5 Northern, M.P., var. speed	400–1600
1	5 Northern, back-geared	190
2	6½ Crocker-Wheeler	1325
1	7½ Wagner, M.P.	1450
1	7½ Bullock, enclosed.	1650
1	7½ Paragon, M.P.	1500
1	10 Westinghouse, crane motor	750
1	10 Paragon, M.P.	1150
1	10 West. Elec., M.P.	1125
3	10 Gen. Elec., C.E.	1500
1	10 Holtzer-Cabot	1375
1	10 Gen. Elec.	800
1	10 Westinghouse	1250
1	12 Jenney	1600
1	12 Thomson-Houston	1400
1	12 Amer. Eng. Co.	1200
1	15 Commercial, M.P.	1200
1	15 Paragon, M.P.	1200
1	15 Gibbs, M.P.	725
1	20 Sturtevant	750
1	20 Sprague-Lundell.	1080
1	20 Lundell, M.P.	725
10	30 Walker, series, back-geared	485–100
1	30 Triumph, M.P.	830
7	35 Bernard, M.P.	525

Rossiter, MacGovern & Co.

ESTABLISHED 1893 (INCORPORATED)

Electrical Apparatus of All Kinds.

WEST STREET BLDG., 90 WEST STREET, NEW YORK **TELEPHONE, CORTLANDT 6975-6**

We have Just Purchased Complete Plant Consisting of the Following 2-Phase, 60-Cycle, 220-Volt Alternating Motors, Complete with Rails, Pulley and Auto Starters:

1—2 H.P. Westinghouse, Type C, 1700 R.P.M.
1—2 H.P. Westinghouse, Type CCL, 1120 R.P.M.
2—3 H.P. Westinghouse, Type CCL, 1120 R.P.M.
1—5 H.P. Westinghouse, Type CCL, 1120 R.P.M.
1—10 H.P. Westinghouse, Type CCL, 1120 R.P.M.
2—10 H.P. Westinghouse, Type H, 1120 R.P.M.
3—15 H.P. Westinghouse, Type CCL, 1120 R.P.M.
1—20 H.P. Westinghouse, Type CCL, 1120 R.P.M.
2—30 H.P. Westinghouse, Type C, 850 R.P.M.
1—35 H.P. General Electric, Type K, 900 R.P.M.
3—40 H.P. Westinghouse, Type C, 850 R.P.M.
1—40 H.P. Westinghouse, Type CCL, 1120 R.P.M.
2—50 H.P. Westinghouse, Type C, 850 R.P.M.
4—50 H.P. Westinghouse, Type CCL, 850 R.P.M.
1—50 H.P. General Electric, Type K, 720 R.P.M.

WRITE US FOR FULL PARTICULARS OF THE ABOVE.

SEND FOR LIST OF POWER HOUSE EQUIPMENT AND OTHER ELECTRICAL APPARATUS

COMMONWEALTH EDISON CO.

REPAIR SHOPS

76 MARKET ST., CHICAGO. TELEPHONE RANDOLPH 1280.

FIRST-CLASS EQUIPMENT THROUGHOUT

DYNAMOS, ARMATURES, MOTORS, ARC LAMPS, INSTRUMENTS, HIGH GRADE MACHINE WORK OF ALL KINDS

CORRESPONDENCE SOLICITED.

SPARKING

reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire. All of this may be avoided if you use

The only article that will prevent sparking. Will keep the commutator in good condition and prevent cutting. Absolutely will not gum the brushes.

It will put that high gloss on the commutator you have so long sought after

Send for Stick **50c. PER STICK** **$5.00 PER DOZ.**

For Sale by All Supply Houses or **K. McLENNAN & CO.** Sole Manufacturers

Room 411—130 Dearborn St., CHICAGO

POSITIONS WANTED

(*Continued from page 75.*)

MAN with salesmanship ability, 30 years old, technical graduate, eight years' experience in mechanical and electrical engineering, desires to locate with manufacturing company. Will take inside work until familiar with line of goods. Address 5746, care of Electrical World, New York.

ELECTRICAL ENGINEER desires position with manufacturing company of electrical machinery. Experienced in the electrical and mechanical design of motors and generators, thoroughly familiar with shop and office system; solicits correspondence or personal interview. Address No. 5747, care of Electrical World, New York.

POSITION WANTED.—As manager of street railway or lighting property by well qualified married man, who can furnish satisfactory references and make good what is said in them should he be employed. Address No. 5748, care of Electrical World, New York.

WANTED.—Position as superintendent of plant in Southwestern town from 5,000 to 20,000 population. Cornell graduate, age 27, three years' experience in construction and central station work. Would also consider position in charge of meter department in larger town. Address No. 5749, care of Electrical World, 590 Old Colony Building, Chicago, Ill.

ELECTRICAL ENGINEER, with first-class experience in steel mill practice, desires position as electrical superintendent with steel company or any company with large power equipment. Similiar position, but will make change. Desire Eastern location. Technical graduate, member of Assocn. E. E. I. & S. Industry. References. Address K. V. A., No. 5750, care of Electrical World, New York.

POSITION WANTED.—As helper by electrical trade school graduate. I am familiar with every branch of the trade; would like position in central station or electrical supply house. Address No. 5737, care of Electrical World, New York.

SITUATION WANTED.—By practical man as foreman or superintendent for construction of electric railroad and signal and telephone system; 16 years' experience, including line and submarine work. Holding N. Y. City engineer's license. Capable of erecting any plant of steam, electric and refrigerating. Any country or part of country. Four languages spoken. Address No. 5740, care of Electrical World, New York.

WANTED—Opportunity. Engineer, age 30, whose chief experience has been in superintending the construction of large, fireproof buildings and the equipment of power plants and electrical installations, would like to change his present position to one with a firm of architects, contractors or consulting engineers. Has some capital. Can go anywhere. Address No. 5733, care of Electrical World, New York.

HELP WANTED

The rate for "Help Wanted" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words three cents each, payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

Replies may be sent in care of Electrical World, 239 West Thirty-ninth Street, New York, or 590 Old Colony Building, Chicago, as advertisers may desire.

(In replying to a "Want" advertisement, original letters of recommendation should NOT be forwarded.)

WANTED.—Manufacturers' agents and salesmen on commission by manufacturers of a high-grade incandescent electric lamp. Address No. 3320, care of Electrical World, New York.

METER MEN.—Wanted, men interested in meter and instrument work, to take up the course on "Electrical Measuring Instruments and Meters," as prepared by the Fort Wayne Electrical Correspondence School, Fort Wayne, Ind. Write for free catalogue giving information on meter testing.

WANTED.—Mechanical draftsmen, with experience on electrical apparatus, generators, motors and transformers. State experience and salary expected. Only first-class men need apply. Address Chief Draftsman, Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

HELP WANTED.—An experienced factory man, in building both alternating and direct current motors and generators. Must be familiar with modern methods for reducing manufacturing costs, capable of handling men and a hustler. State age, qualifications and salary expected. Address Ideal Electric & Mfg. Co., Mansfield, Ohio.

FIRST-CLASS mechanical draftsman and designer who has had extended experience on steam engine design, also one thoroughly familiar with the mechanical design of electrical apparatus, wanted for permanent positions. Only competent men need apply by giving full particulars about age, education, experience and salary expected. Address Engineer-in-charge, Drawing Office, General Electric Co., West Lynn, Mass.

WANTED.—By consulting engineer, a solicitor well acquainted among architects and builders in New York and vicinity, to obtain propositions on industrial engineering and design of isolated plants. Give full particulars and salary expected. Address No. 5744, care of Electrical World, New York.

EXPERIENCED salesman for electrical supplies. One who has a clientage in Pennsylvania, New York or Eastern territory preferred. Must be of good character and habits and come well recommended. Address, giving age, experience and salary expected, No. 5741, care of Electrical World, New York.

WANTED.—An experienced Electrical Engineer thoroughly familiar with the electrical and mechanical design of Induction Motors. Must be a technical graduate. Write fully, giving age, qualifications, experience and salary expected. Address No. 5732, care of Electrical World, New York.

(*Continued on page 78.*)

GAS ENGINE—Special Bargain

85 H.P. Westinghouse 3-cylinder, vertical gas engine, perfect condition.
175 K.W. Westinghouse 2-ph., 60-cy., 2,200-v. Generator, direct con.
250 H.P. Buckeye Tandem Comp. Engine.

550 VOLT APPARATUS

400 K.W. Crocker-Wheeler, dir. con. Bates Corliss tandem engine.
250 K.W. Wghse., dir. con. Hamilton Corliss tandem engine.
225 K.W. G. E., dir. con. Ideal tandem engine.
225 K.W. G. E., dir. con. Clarke simple engine.
500 K.W. Bullock, 6-pole, belted type.
500 K.W. General Electric, 6-pole.
350 K.W. Bullock, 8-pole.
300 K.W. Westinghouse, 6-pole.
225 K.W. Westinghouse, 6-pole.
200 K.W. G. E. and Westinghouse, 4-pole.
150 K.W. General Electric, 6-pole.
100 K.W. Westinghouse, 6-pole.
Large stock of motors.

220 TO 250 VOLT APPARATUS

800 K.W., 400 K.W., 200 K.W. and 120 K.W. three-wire direct connected sets.
75 K.W. Sturtevant, 8-pole, dir. con. Sturvetant hor. engine.
75 K.W. G. E., 6-pole, dir. con. Watertown engine.
150 K.W. G. E., 6-pole, belted type.
125 K.W. C. & C., belted type.
75 K.W. C. & C., belted type.
25 H.P. Westinghouse Motor.
Two 30 K.W. Westinghouse, belted.

110 TO 125 VOLT APPARATUS

100 K.W. Crocker-Wheeler, dir. con. Harrisburg engine.
50 K.W. Westinghouse, dir. con. Ideal engine.
40 K.W. Sprague, dir. con. vertical engine.
60 K.W. General Electric, 6-pole dir. con. Harrisburg engine.
45 K.W. General Electric, 4-pole belted.
85 K.W. General Electric, 6-pole belted.
Two 25 K.W. General Electric belted.
Complete stock of 125-volt belted dynamos and motors.

ALTERNATING CURRENT APPARATUS

Send for complete Stock List of single, 2- and 3-phase belted and direct connected units.

ENGINES AND BOILERS

Send for complete Stock List.

Joseph H. Thompson, Jr. 17 BATTERY PLACE NEW YORK

Look at These Bargains

on New and Used

Electrical Machinery

2—13x12, Erie City Automatic Steam Engines, 120 HP at 300 RPM on 100 lbs. Steam Pressure, each - - - - $430.00

2—90 KW 1100 V 1100 RPM Standard Mfg. Co. 133 cycle, single phase Alternators, complete with base, pulley, field regulator and exciter, each, - - - - - - - $475.00

2—50 KW 25 to 60 cycle Transformers, new—original value, $1500.00—Our price for both - - - - $1000.00

AS GOOD AS NEW

Bargain Booklet Number Two shows many more at just as attractive prices. Write for it. It is worth your while.

THE F. BISSELL COMPANY.

Toledo, Ohio

220-250 VOLT DIRECT CONNECTED AND BELTED UNITS

Direct Current: Immediate Delivery

One 100 K. W. Walker D. C. to Watertown engine.
One 75 K. W. General Electric D.C. to Harrisburg engine
One 50 K. W. Walker D.C. to Watertown engine.
One 35 K. W. C. & C. D.C. to Payne engine.
Two 15 K. W. Crocker-Wheeler D.C. to gas engines.
One 200 K. W. Crocker-Wheeler, 3 bearing, 450 RPM.
One 125 K. W. C. & C., 6 pole, 450 RPM.
One 100 K. W. General Electric, 4 pole, form H, 650 RPM.
Two 100 K. W. Crocker-Wheeler, 6 pole, 650 RPM.

We buy, sell, rent and repair.

YEARSLEY, LEVENE & CO.

211 North Third Street PHILADELPHIA, PA.

FOR SALE

On account of changing our distributing system in the center of the city from alternating current to direct current, we have on hand for sale a large number of alternating current NERNST LAMPS in 3, 4 and 6 glower sizes. They are in good operating condition and are for sale at one-half the cost of new lamps. Immediate shipment can be made.

Address for particulars,

PORTLAND RAILWAY, LIGHT AND POWER COMPANY
Portland, Oregon.

Any Electrical Book

you want supplied promptly

McGRAW PUBLISHING CO.

(Book Dept.) 239 W. 39th St., New York

HELP WANTED

(Continued from page 77.)

WANTED.—An educational institution in Greater New York requires an instructor in electrical engineering laboratory, to report for work September 10, 1909. Salary about $1,400 or $1,500 at start, with future increase. Applicants must be between 25 and 32 years of age, and graduates in electrical engineering from a college of high grade, and must have had several years of good, practical experience. Teaching experience in day or evening courses would also be in applicant's favor. To insure reply, give full statement of qualifications. Address No. 5742, care of Electrical World, New York.

A DESIGNING ENGINEER for A. C. and D. C. generator design, for large manufacturing firm in Canada. State experience and salary expected. Address No. 5731, care of Electrical World, New York.

MISCELLANEOUS

The rate for "Miscellaneous" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words three cents each, payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

MAKERS of machines suitable for covering wires and cables with fibrous asbestos, please communicate with "Cables," care of Neyroud & Sons, Advertising Agents, 14 Queen Victoria St., London, E. C.

ELECTRICAL INVENTORS should engage a *technical* patent attorney to apply for their patents, because Patent Office Examiners are *technical* experts. No Examiner, nor other attorney than undersigned is member of both A. I. E. E. and A. S. M. E. Mail invention for free advice, opinion, booklet and estimate. Delay dangerous. Edward P. Thompson, M. E., Registered Patent Attorney, McGill Building, Washington, D. C.

OPEN FOR DEMONSTRATIONS. — The Jones Dry Goods Company, of Kansas City, Missouri, are open to consider propositions from manufacturers of articles of popular demand, for the demonstration and sale of their products. In writing please give full details, as only such articles as are meritorious or that can be made popular will be considered. We will also consider the leasing of departments of specialties, not conflicting with our own departments.

AN engineer and business man now about to visit Europe, well qualified along technical and industrial lines, familiar with business conditions, export and patent matters abroad, desires to take on a few more first-class propositions from manufacturing concerns or others who wish to extend or build up a trade, particularly in patented articles with foreign countries. References given. Address No. 5753, care of Electrical World, New York.

PROFITABLE, established electrical construction and jobbing business for sale to close an estate. Good opportunity for electrical man. For particulars address Robert Ackerman, Executor, 309 Ackerman Bldg., Binghamton, N. Y.

SECRETARY-TREASURER.

A holding company, organized to purchase and operate gas and electric properties, requires the services of a competent man for the position of Secretary and Treasurer. Successful applicant must come well recommended, thoroughly understand bookkeeping, stenography and typewriting and appreciate the necessity of close application to his duties. An investment in the company is required, which will be amply secured by interest-bearing bonds. This company, although comparatively young, is in successful operation and on a paying basis; the position opened offers an excellent opportunity for the right man to get in on the ground floor of an organization with an exceedingly bright future. All replies in confidence. Address 5743, care Electrical World, New York.

WANTED.—Young men who are high school graduates, with some telephone experience, or who are graduates of technical schools, to take our apprenticeship course in Automatic Telephony. Write for full information to Supt., Automatic Electric Co., Chicago, Ill., W. L. Campbell.

PROPOSALS

The rate for "Proposal" advertisements is 15 cents per line, payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

TENDERS will be received by the City of Toronto, Canada, up till noon of June 30th, 1909, for laying between 350,000 and 450,000 duct feet of underground conduit.

For specifications, form of tender, etc., apply Electrical Department, City Hall.

Frank MacGovern J. Warren Archer

MacGovern, Archer & Co.

Electrical and Steam Machinery

114-118 Liberty Street: 'PHONE: CORT. 5577 NEW YORK

DYNAMOS AND MOTORS—ALL IN STOCK

Turbo-Generator Sets

2—2000 KW, Curtis G. E., 3 phase, 25 cycle, 6600 volts.
1—1500 KW, Curtis G. E., 3 phase, 60 cycle, 2300 volts.
1— 500 KW, Curtis G. E., 3 phase, 60 cycle, 2300 volts.

Direct Current Direct Connected Units

2—225 KW, Westinghouse, 8 pole, 575 volts, 250 RPM, each d.c. to an 18&30x16 vertical Westinghouse engine (Rites governor).
2—200 KW, General Electric, 8 pole, 250 volts, 200 RPM, each with a 14&28x16 in. C.C. Ball & Wood engine.
1—200 KW, Westinghouse, 250 volts, compound-wound generator, 200 RPM, direct-connected to 16&28x18 in. vertical cross compound Erie Ball engine.
1—170 KW, General Electric, 250 volts, 8 pole, compound wound, direct-connected to 15&26x36 in. cross compound Cooper Corliss engine.
2—150 KW, Crocker Wheeler, 115-125 volts, 8 pole type, speed 160 RPM, each with a heavy duty 4 valve type horizontal McIntosh & Seymour engine.
1—100 KW, General Electric, 125 volts, 6 pole, speed 250 RPM, with 16x15 in. horizontal McIntosh & Seymour engine.

Engines

2—18&36x48 Whitehill Corliss, heavy duty.
1—22&44x48 Whitehill Corliss, heavy duty.
2—11&19x12 Ball & Wood, 4 valve horizontal.
1—16x15 McIntosh & Seymour.
1—13x12 Ames Iron Works.
1—12x14 Ball & Wood Automatic.

110-125 Volt Direct Current

1—60 KW, Edison, Compound.
1—55 KW, G. E., 4 pole, Form H.
1—40 KW, Crocker-Wheeler, 1050 RPM.
1—12½ KW. Westinghouse-M.P.

Alternating Current Dynamos (Belted)

1—300 KW, 3 phase, West., 60 cycle, 2200 volts, 300 RPM.
2—250 KW, 3 phase, G. E., 60 cycle, 2300 volts, 450 RPM.
2—200 KW, 3 phase, G. E., ATB, 60 cycle, 600 RPM, 2300 volts.
1— 75 KW, 3 phase, G. E., ATB, 60 cycle, 2300 volts, 900 RPM.
1—180 KW, 2 phase, West., 60 cycle, 2300 volts, 514 RPM.
2—180 KW, 2 phase, Stanley, 60 cycle, 2300 volts, 600 R.P.M.
2— 75 KW, 2 phase, West., 60 cycle, 2200 volts, 720 RPM.
2—120 KW, 1 phase, G. E., 125 cycle, 1100 volts, 1070 RPM.

A. C. Direct Connected Units (60 Cycle)

1—300 KW, G. E., 3 phase, A. T. B., 150 RPM, 2300 volts, with 14&28x30 in. C.C. McIntosh & Seymour engine.
1—250 KW, West., 3 phase, 220-440 volts, 257 RPM, with new C.C. Erie Ball engine.
2—250 KW, 2200-volt, 3-phase, 60-cycle Westinghouse alternators, each direct-connected to 16&27x16 in. Westinghouse compound vertical engine.
1—75 KW, West., 1 phase, 2200 volts, 257 RPM, with 11&20x12 in. T.C., 4 valve Ball & Wood engine.

220-250 Volt Direct Current

1—200 KW, Bullock, 6 pole, 635 RPM.
1—150 KW, G. E., 6 pole, 525 RPM.
1— 60 KW, Crocker-Wheeler, 650 RPM.
1— 50 KW, Bullock, 460 RPM.
1— 35 HP, West., 575 RPM, Type S.
1— 25 HP, West., 850 RPM, Type S.
1— 15 HP, G. E., 4 pole, 635 RPM.

500-550 Volt Direct Current

1— 50 HP, West., 550 RPM (new).
1— 30 HP, West., 850 RPM, Type S.
1— 25 HP, G. E., 650 RPM, Type H.
1— 20 HP, West., 1040 RPM, Type S.
2— 15 HP, G. E., 1200 RPM, Type CE.
1— 1 HP, G. E., 1575 RPM, Type CQ.

25-Cycle, 3-Phase Motors

1— 50 HP, G. E., Form L, 500 RPM, 550-440 or 220 volts (new).
1— 75 HP, West., C, 480 RPM (new).
1—100 HP, G. E., Form K, 500 RPM, 220 or 440 volts (new).

60-Cycle, 2-Phase Motors

1—125 HP, West., C, 2200 volts, 720 RPM.
1—100 HP, G. E., 220-440 volts, L, 600 RPM.
1— 15 HP, G. E., 220 volts, K, 1200 RPM.

60-Cycle, 3-Phase Motors

3—125 HP, West., C, 2200 volts, 720 RPM.

All of the above Machinery can be delivered immediately and is in the very best of condition
Send for full list of Dynamos, Motors, Engines and Electrical and Steam Machinery of every description

BE INDEPENDENT

OWN AN ELECTRIC LIGHTING PLANT

We have a number of attractive opportunities to offer in different sections of the country. If you have $3,000 or more, write us.

THE GAS & ELECTRIC DEVELOPMENT CO.
1328 Chestnut Street, Philadelphia, Pa.

IMMEDIATE SHIPMENT

3 Phase Alternators

1-250 K.W. 60 cy. G.E. A.T.B. dr. en. to Cross Compound Engine.
1-200 K.W. 60 cy. G.E. A.T.B. belted.
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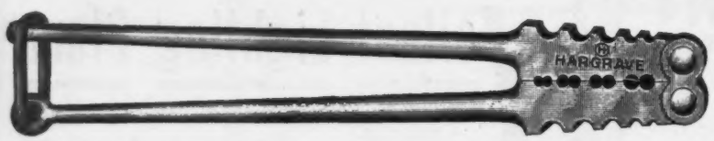

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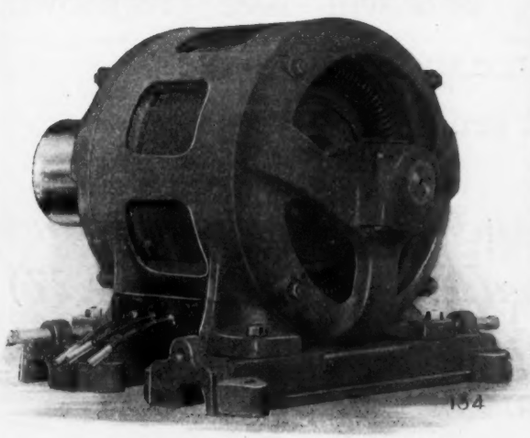

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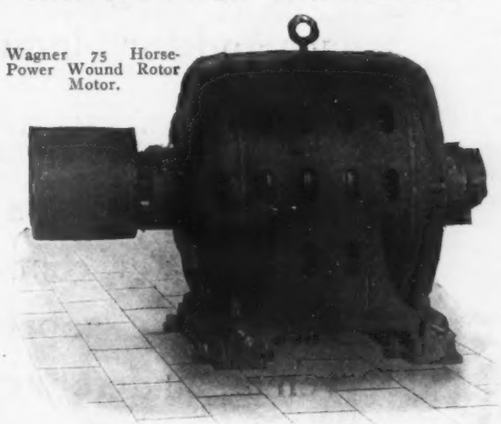

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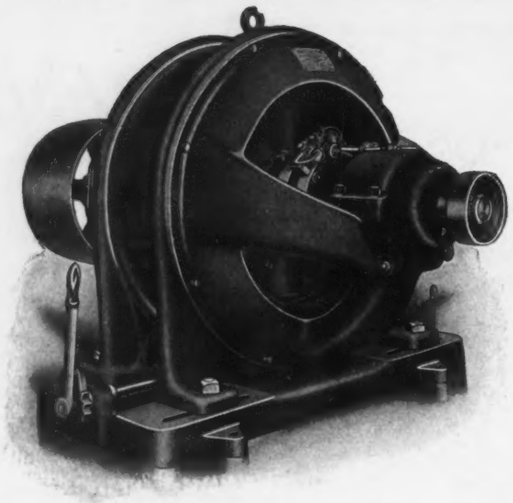

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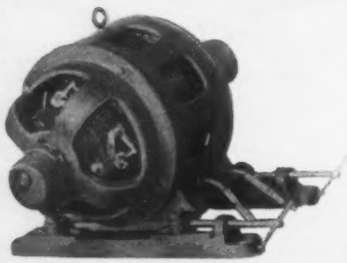

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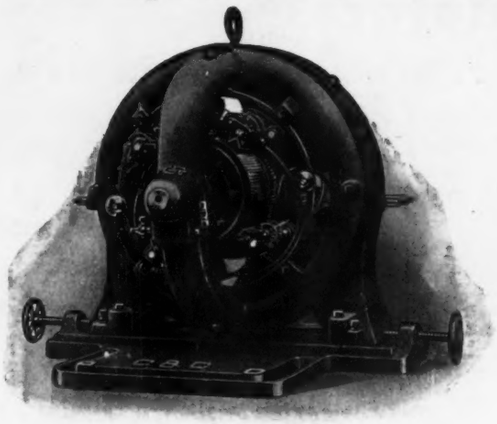

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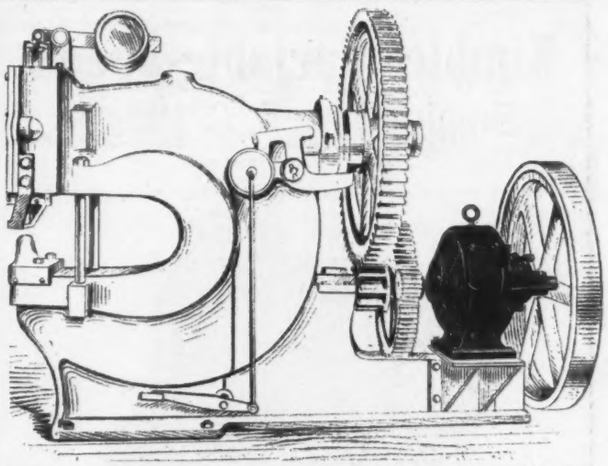

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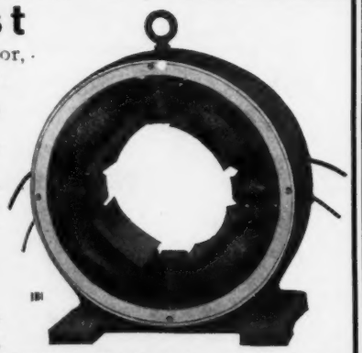

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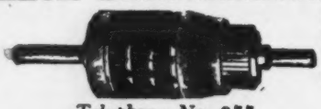

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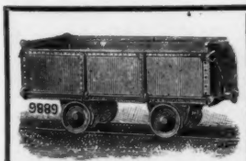

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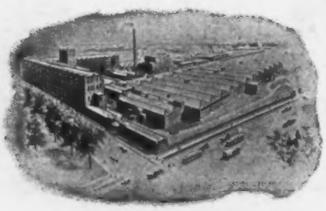

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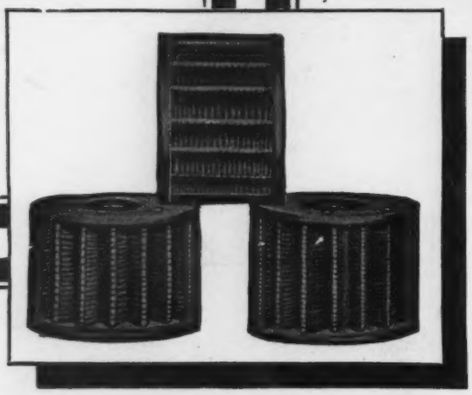

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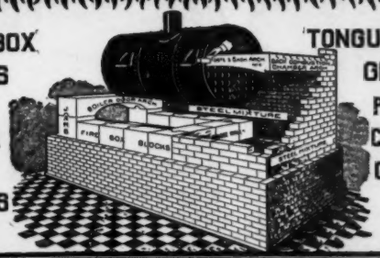

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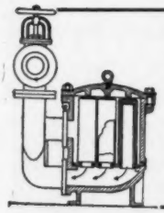

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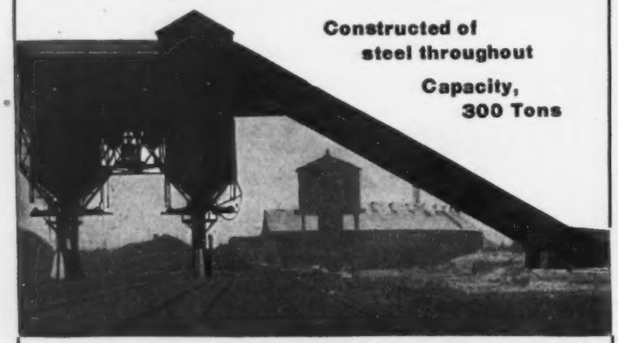

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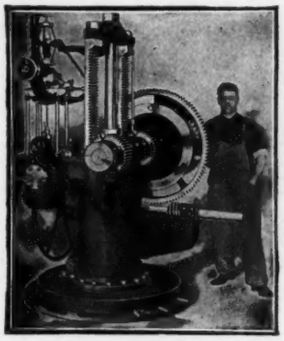

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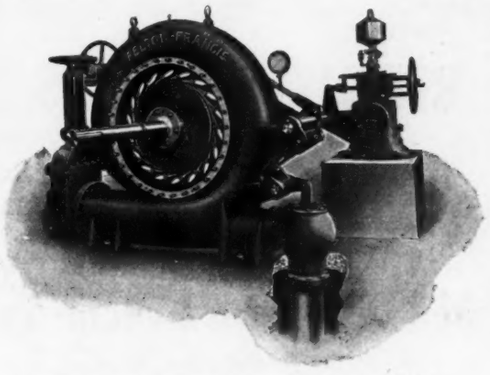

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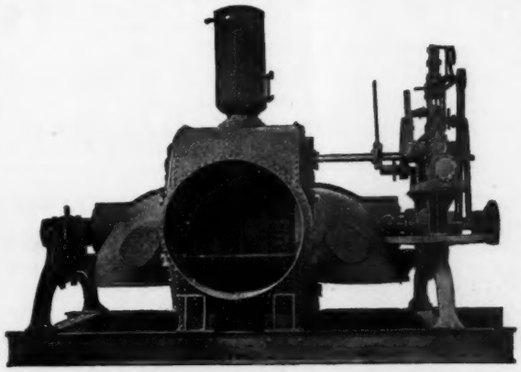

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Peerless Piston and Valve Rod Packing

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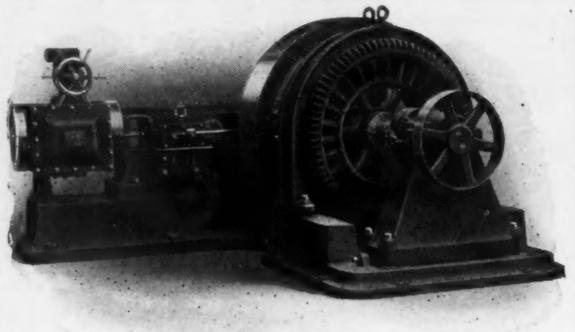

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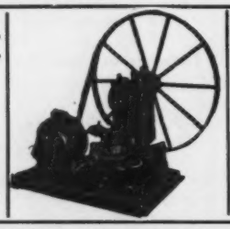

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We build and install complete Gas Engine Plants.

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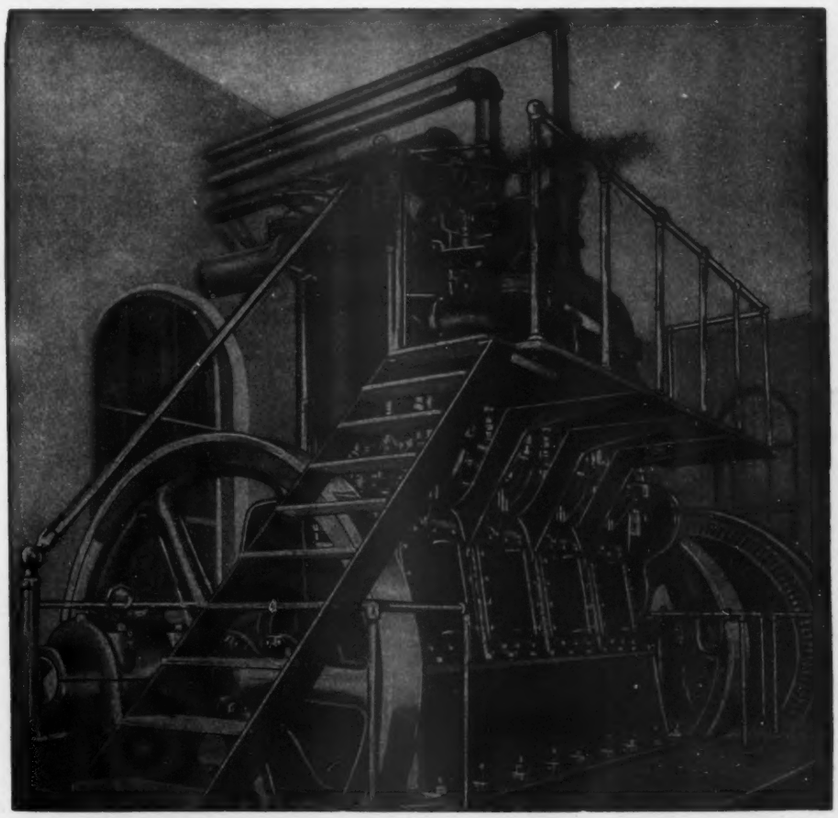

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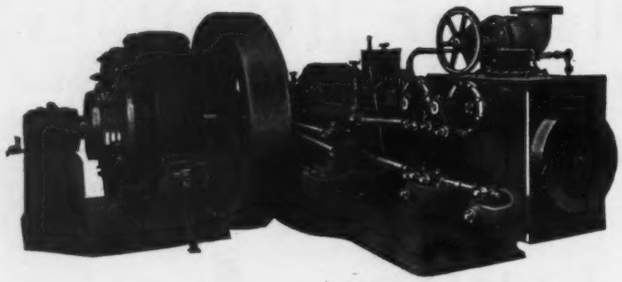

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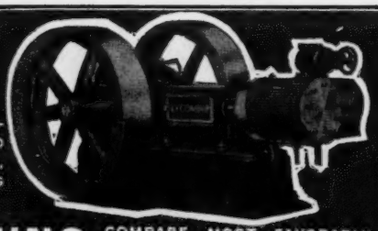
IS A FALSE STANDARD BY WHICH TO JUDGE AN ENGINE, YET EVEN IN THIS RESPECT



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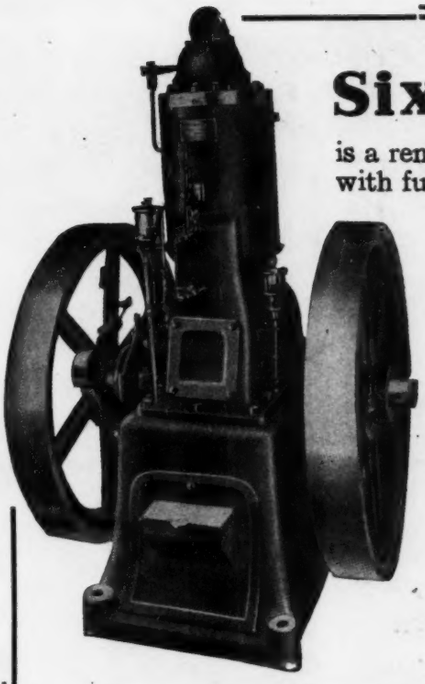
Run for months without adjustment or new oil.
Unequaled for Generator Sets and Exciters. 3



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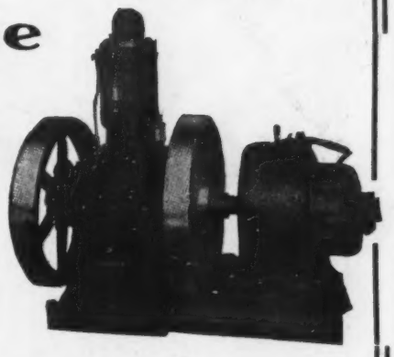

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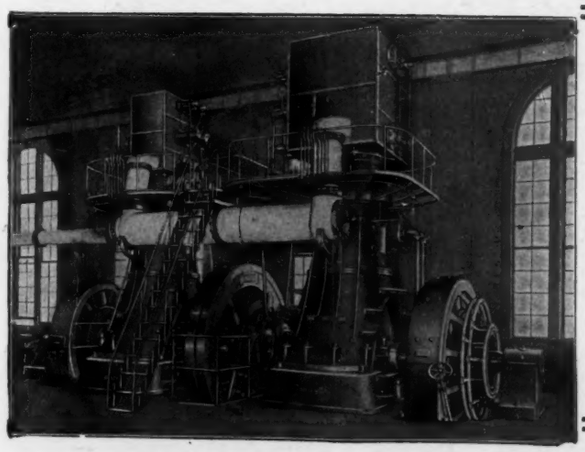

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Type "C" Watt Hour Meters

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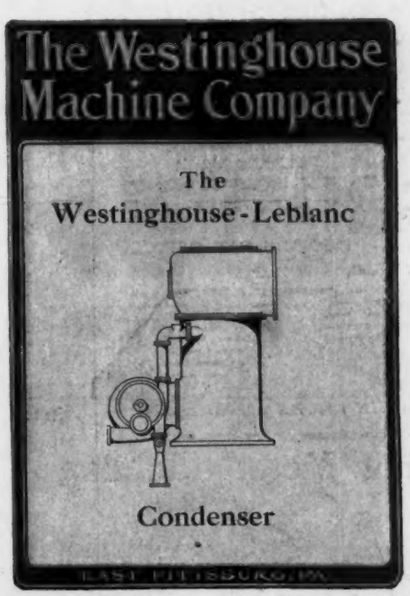

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Take a look at any oak-tanned belt running over a small pulley. The belt is probably so stiff that it only has a 120° contact when it should have 180°.

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